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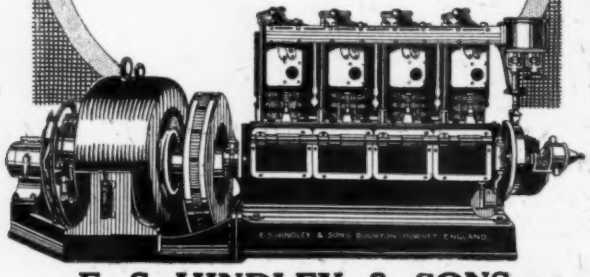

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THE

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VOL. XC. JUNE 23, 1922. No. 2,326.

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THE SOUTH-EASTERN INQUIRY.

THE inquiry, which closed last week, into the applications by the South-Eastern & Chatham Railway Companies and the West Kent Electricity Co. for sanction to erect generating stations, both of them intended to supply the electrified lines of the S.E. and C. & D. Railways, was the first in which the Commissioners had to deal with an application by a railway company for authority to establish a station for its own traction purposes. It therefore has the interest of a precedent.

Both applications come under Section 11 of the Act of 1919, but with a difference in the discretion allowed to the Commissioners. As regards the West Kent application, the Commissioners have no specific limitation to their action. They can withhold consent, or give consent subject to conditions; there is no obligation put on them to impose conditions, but in the nature of things an unconditional consent to an authorised undertaker in the London district is hardly thinkable.

In the case of a railway company proposing to use electricity for traction, "consent shall not be refused, unless it is proved to the satisfaction of the Electricity Commissioners that a joint electricity authority or authorised undertakers are or will be willing and in a position to give the railway company a supply of electricity, adequate in quantity and regularity, to meet the present and prospective demand of the railway company, at a cost not greater than would have been incurred by the railway company in supplying themselves."

As the railway electrification is in the future, estimated to be completed, in its first stage, in June, 1925, only the words of the section applying to the future have to be considered. It was proper to take the two applications together, although they are in different categories, because the West Kent Co. made the prospective supply of the railway load one of the bases of the application. To that extent the two applications were competitive, and were properly heard together.

It must be admitted that the task put upon the Commissioners in this case is sufficiently onerous. As between the two applicants they have to consider estimates of the capital costs and the working costs of two hypothetical stations which it will take nearly three years to erect. Besides these, they also had to consider an offer from another authorised undertaker also involving a station not yet in existence, but a little more advanced in preliminaries, since the Commissioners have already consented to its erection, and some load awaits it.

Against the uncertainty of predicating actual costs of stations which will not be in operation for nearly three years, it may be said, of course, that some of the changes in prices which may occur in that time will affect the costs in similar ways. But it is conceivable that such changes will not all affect the ultimate costs or prices proportionately.

The Commissioners, therefore, were obliged to make their inquiry searching and detailed, for they want all the information possible to enable them to discharge the onus laid upon them.

But it may be suggested, with deference, that the inquiry might have been shortened without any loss in essentials, if the procedure had been conducted in accordance with regulations which the Commissioners have power to make. The actual course of the hearing was somewhat confusing, and the procedure not by any means what one expects in a quasi-judicial inquiry.

Perhaps the most striking feature was the laxity in respect of *locus*. The London County Council and the Conference of Local Authority Undertakers are no doubt interested in the erection of new generating stations, and entitled to oppose applications which they think may prejudice that reorganisation of London electricity supply which is in process of elaboration.

But it is very difficult to understand what *locus* the L.C.C. had, justifying its counsel in cross-examining and speaking as if undertakers who appeared only to say what offers they could make to the railway were promoters whom the L.C.C. was entitled to oppose. As a fact, these undertakers had no application before the Commissioners, and required no consent from the Commissioners to make such offers or even to enter into a definite contract with the railways. But, worded as the section is, they were bound to put in their offer and to support it by evidence. The L.C.C. is not, and cannot be, in competition with such undertakers.

Judged by the criteria of the procedure before Parliamentary Committees and in statutory inquiries of a similar character, this action seems to be essentially out of order. It was not the only incident of the inquiry to which similar remarks are applicable, and whilst the evident wish of the Commissioners to hear and consider everything relevant is wholly praiseworthy, it does seem that they could save their own time, and that of the parties to these inquiries, by making and enforcing regulations in respect of procedure which, while protecting the interests of all concerned, would put some curb on irrelevancies and loquacities which only darken counsel.

The Commissioners' task in this case would have been lightened if the proposed Joint Electricity Authority for London had been already in existence; they might, indeed, not have had to essay it at all. But they cannot be charged with responsibility for the delay in setting up that authority.

The I.M.E.A. and "Service."

Mr. S. T. Allen, in his presidential address, took a broad view of the duties and responsibilities of the electrical supply industry *vis-à-vis* to the whole of the industries of the country, emphasising the urgent necessity of adopting every possible method of restoring prosperity and decreasing unemployment. No doubt there is a tendency for the manager of an isolated electricity supply undertaking gradually to become engrossed in local routine and to lose sight of the wider interests with which, by virtue of his public service, his business is interlinked; we are all liable to get into a groove, and the President by calling attention to the obligation that rests upon every individual to cherish high ideals and personally to foster the welfare of the whole community performed a most useful function. We were pleased, too, that he deprecated the narrow-minded idea that indiscriminate curtailment of expenditure is necessarily economical; on the contrary, as we have often pointed out, it is sometimes the truest economy to spend freely, but with discretion, choosing those objects which are calculated to provide the largest return in the form of increased employment and output and reduction in cost of commodities. Individual efforts towards progress on such lines are truly co-operative, for, like the little runnels which combine to form streams and ultimately give birth to a great river, however diversified they may be at the start, they all tend towards the same goal—the common good; and that was the note on which Mr. Allen ended his admirable address, with a reference to the benefits to be derived from the schemes for joint working in electricity supply which are shortly to come into operation.

Hackney Points a Way.

In our pages to-day will be found the details of a scheme for cheapening the supply of electricity to domestic consumers, drawn up by the Hackney borough electrical engineer, Mr. L. L. Robinson.

As we have pointed out, much has already been done in Hackney to encourage the use of electricity in the home. The electricity department is a willing servant of its consumers, the prices are comparable with any in this country, and the exhibition recently held there was one of the best of local exhibitions that has yet come to our notice.

We are aware that so far as the portion of the scheme which relates to lighting is concerned, it is not an innovation, but we believe that the proposal to treat cooking and heating apparatus in the same way is a new departure for the electricity supply industry. We see no reason for regretting that the idea has already been exploited by the gas industry; adapted ideas are sometimes better than entirely new ones, and, moreover, they often possess the merit of having been tried and found successful. For many years past we have urged the necessity for a scheme of this kind to make electrical heating and cooking a real "load" for the supply station. While apparatus is so dear, a condition brought about chiefly by the lack of demand, it is useless to expect electrical cooking to assume the proportions which are desired by all connected with the supply industry. Hire and hire-purchase systems have no doubt accomplished a great deal, but a system in which the cost of apparatus is practically imperceptible will secure a greater amount of public favour. We think that the Hackney consumers may be considered very fortunate, for even with the addition to the cost per unit of energy, they will be paying a far lower price than the majority of domestic users in this country.

We are glad that the scheme is to be tried on a sufficiently large scale to gauge results with certainty, and we have no doubt that engineers in charge of similar undertakings will keep an eye on Hackney. We hope that the outcome will be the adoption of this, or perhaps a better scheme, including provision for continuous water-heating and a two-part tariff, in many other undertakings.

Hopes of Swedish Revival.

Sweden, whose wealth of water-power furnishes a natural incentive to the production of electrical energy, has, of course, established a manufacturing industry for the purpose of coping with the consequent demand for electrical equipment. During each of the years 1920 and 1921 exports of electrical machinery and accessories amounted in value to approximately £1,000,000. At the same time Sweden is an importer of electrical machinery and apparatus, though the value of that brought from abroad has diminished during recent years. It amounted in 1921 to about £600,000, as compared with £706,000 in 1920.

It will be seen therefore that the country possesses a certain interest for the British electrical engineer. There is good hope that this interest may be cultivated with profit in the near future, for there are signs of a revival in Swedish trade due partly to a wages adjustment that is taking place and partly to a decline in the severity of German competition. The effect which the new situation in Sweden is likely to exercise on certain branches of the British iron and steel and engineering trades is described in a report by H.M. Commercial Secretary at Stockholm, which is summarised on another page of this issue.

THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

THE ANNUAL CONVENTION AT WOLVERHAMPTON.

On Tuesday last the Convention was opened at Wolverhampton under most favourable conditions; the weather was fair, and there was a large attendance—some 400 members and guests—from all parts of the country, Wolverhampton being in a central and very accessible position. Many had arrived on the previous day and taken up their quarters, either at Wolverhampton or at Birmingham, the accommodation at the former town being naturally somewhat overtaxed by the influx of visitors; but the distance is not great, and an excellent railway service is provided between the two centres. Moreover, as Wednesday was spent at Stoke-on-Trent, and Thursday at Birmingham, the "honours were easy" so far as convenience was concerned.

Electrically speaking, Wolverhampton was early distinguished by being the domicile of one of the pioneer manufacturing companies—Elwell-Parker, Ltd., whose works were opened as long ago as 1880; the firm played a prominent part in developing the new industry, and many of its products were still in operation until recent years. In 1889 the Electric Construction Corporation, Ltd., took over the business. The Electric Construction Co., Ltd., which is the present style of the concern, was formed in 1893, and has a subscribed capital of over three quarters of a million sterling. From this company's factory have come some of the largest generators ever built in this country, including those originally installed by the London County Council at its Greenwich power station; the company in 1891 equipped the whole of the South Staffordshire tramways with the overhead trolley system, and in the following year carried out the equipment of the Liverpool Overhead Railway—two pioneer feats of the first importance—and has always maintained an honoured place in the front rank of British electrical firms.

Another notable feature of Wolverhampton was the electric tramway on the Lorain surface-contact system, which was opened in 1902 and successfully operated for nearly 20 years. As has been announced in our pages, the surface-contact system is now being superseded by the overhead trolley; not, however, because of any inherent defect in the former, but simply because the equipment was worn out, and the cost of its renewal would have been greater than that of conversion to the overhead system, which, moreover, enabled through-running powers to be arranged in conjunction with the adjoining tramway systems.

But in view of the occupancy of the presidential chair of the I.M.E.A. by Mr. S. T. Allen, chief electrical engineer and manager to the Corporation, chief interest naturally attaches to the municipal electricity works, which are to be visited to-day. The works were opened by Lord Kelvin—a rare distinction—in 1895, and operated on the d.c. system, which was supplemented by a high-pressure d.c. supply to the suburbs at 2,000 volts. But great changes have taken place, of which a detailed account was given in the Electrical Review of July 30th, 1920. During the war the demand for power necessitated large extensions and a drastic reconstruction and re-equipment of the generating station, as well as the complete reorganisation of the whole system, alternating-current generation and transmission being adopted, with conversion to direct current for the original network and the tramways. In 1914 the plant installed had a capacity of 7,200 kW; in 1920 the capacity had been raised to 23,500 kW, wholly three-phase, and turbo-generators had taken the place of the older machines, whilst the boiler-house equipment had been modernised. The most noteworthy feature of the reconstruction was the fact that the engine-room walls were raised, a new crane gantry was provided, and a new roof was constructed, without interfering with the running of the plant; the switchboards were removed, and the d.c. switchgear re-erected, with additional a.c. switchgear; and a new boiler house and cooling towers were built. A root-and-branch reconstruction of this magnitude affords the engineer worry enough under normal conditions, but to carry it out during the war and whilst supplying a rapidly increasing demand was a far more arduous task. Fortunately Mr. Allen, who came into office in 1913, had planned the extensions before the war broke out. The annual output of energy during the war attained a maximum of 34 million kWh, compared with 13 millions before 1914. Owing to the early start of the extensions, they were carried out at a cost of only £16 per kW, and the plant is remarkably economical of fuel.

Mr. Allen, who has thus so ably handled the engineering side of the undertaking, is exceedingly keen in developing its commercial aspect. He has devoted the closest attention to the administration of the business on both sides, and to the encouragement of the use of electricity for all purposes. He does not, however, confine his activities to the bounds of his own undertaking; he takes a deep interest—and plays an effective part—in labour questions, being chairman of the District Joint Industrial Council for the Electricity Supply Industry, and in the organisation of electricity supply in the North-West Midlands, having been chairman of the Electrical Engineers' Committee which drew up a scheme for that area. In fact, he is the embodiment of the principles which he has set forth so ably in his presidential address, of which we give an abstract below. His portrait was reproduced in our issue of August 12th, 1921.

The Convention was opened at the Grand Theatre, Wolverhampton, where the Mayor (Councillor James Thompson, J.P.), chairman of the Electricity Committee, welcomed the Association. He drew attention to the interesting antiquities of the district and to the many industries for which it was noted; yet, he pointed out, few industrial towns were placed in such delightful surroundings. Apley Terrace had been justly called the Jerusalem of England. He eulogised the merits of Mr. S. T. Allen, both as a successful manager and as an able engineer, who succeeded in making a profit where others made a loss. With the I.M.E.A. in his mind was always associated Mr. H. Faraday Proctor, to whose energy and enthusiasm the Association owed its existence. Electricity supply was undoubtedly a most important industry; this country had learnt that it must modernise its power stations and apply electricity to the driving of machinery to the utmost possible extent, in order to promote the prosperity of its industries.

Mr. Allen thanked his Worship most heartily for the cordial welcome that he had offered to the Association, and then read his presidential address, which was highly appreciated, especially by Committee chairmen, who thought it would awaken their committees to the necessity of a progressive policy.

A cordial vote of thanks to the President was moved by Alderman Beaumont, of St. Marylebone undertaking, who specially emphasised the sentence: "Each section of industry by its action or inaction affects the destinies of other sections."

The address was followed by a paper read by Lieut.-Col. W. A. Vignoles, D.S.O., borough electrical engineer, Grimsby, on "The Extension of the Uses of Electricity for Domestic Purposes." After the discussion, in which there took part Mr. R. B. Mitchell, Mr. L. L. Robinson, Ald. Beaumont, Mr. Charlesworth, Mr. Wordingham, C.B.E., Coun. A. Sinclair, Mr. Hoadley, Mr. Poole (Durban), Mr. J. W. Beauchamp, Mr. Shaw (Ilford), Mr. Wilkinson (Harrogate), and after Lieut.-Col. Vignoles had briefly replied, luncheon was served at

the Royal Artillery Headquarters, at which the members were the guests of the Mayor and the Electricity Committee. A telegram of congratulation was sent to the Prince of Wales, and after the loyal toast, Ald. Beaumont, in proposing the "County Borough of Wolverhampton," referred to the attractions offered to industrial concerns to settle there. Mayor Thompson responded.

The afternoon was spent at Apley Terrace, on the River Severn, where tea was taken; and in the evening a reception was given by the Mayoress of Wolverhampton at the Art Gallery.

(To be continued.)

Presidential Address.

By S. T. Allen, M.I.E.E. (Chief Electrical Engineer and General Manager, Wolverhampton).

(Abstract.)

I think it will generally be considered that the unfortunate economic position which has arisen as an aftermath of the Great War is by far the most important factor affecting not only the prosperity of the electricity supply industry, but almost all of our national industries. In connection with our supply industry, it has been necessary to adjust our outlook, tariffs and operations to the condition of things existing at the moment. It is, however, wrong for us to remain satisfied in doing this, hoping that conditions will improve without efforts on our part being made to bring about that improvement.

It is towards the development and progress of the electricity supply industry that our special attention must be given at the present time, in order that we shall do our share to create that impetus which will hasten the increase of production and sales of commodities manufactured, thus reducing unemployment. The success of the electricity supply industry is dependent upon the success of other trades and industries, and unless those other industries are kept in a healthy condition the electricity supply industry cannot succeed. To help to promote the common interests therefore is to assist our individual interests.

It may appear to many to be quite outside the sphere of an association such as ours to interest itself, for instance, in our export trade; nevertheless the reduction of export trade has in several instances during the last year changed many municipal electrical undertakings, although temporarily only perhaps, from paying to losing concerns. We cannot possibly afford nowadays to ignore the fact that the success of our undertakings is absolutely bound up with the general trade of the country.

The consideration of trade itself calls for a full display of that public spirit and co-operative action which we, as a nation, have developed so highly in other directions. Directly we realise that electricity supply is a national service, we also realise the opportunity of establishing between contending parties within the industry that confidence, the absence of which may have been the cause of troubles and delays in the past.

The day has gone by when anyone could argue that each municipality in its various operations could quite well act on its own behalf, without co-operating with other local authorities through associations like the I.M.E.A. Joint action does often bring about what individual action fails to, and the results of joint counsels are far more fruitful of success than heterogeneous collections of views made by individuals without regard to the views of others.

The I.M.E.A., representing, perhaps, the most important group of electricity supply authorities, will, I feel sure, if it maintains those high ideals which have all along guided its actions, and looks forward with a broad mind towards the improvements in the future rather than back with recriminations at the faults of the past, do its good share towards the betterment of British municipalities, which hold such a high place in the esteem of the world.

One of the most important factors which has special bearing upon successful operation is what I may term the personal element. This factor covers the correct attributes of members of committees and responsible officers, a full sense of responsibility, justice, fairness and truth, a keen intention of framing sound policies which will bear sound and fair criticism, an enthusiastic endeavour to bring about the best results even at personal inconvenience, and perhaps at times in the face of small-minded destructive criticism. The right progressive policies can only be formulated by a manager who has the courage of his convictions, and can only be put into operation after his committee is fully confident that the framer of the policies has explored the whole field of inquiry and without hesitation and with convincing evidence, if necessary, satisfies that body that it is the policy to pursue.

There is, I am afraid, still a tendency in some directions for committees to be dissuaded from a sound progressive policy, under the mistaken idea that expenditure for whatever purpose should, at the present time, be curtailed. This is often due to the fact that little distinction is made between the operations of the non-trading and rate-financed sections of a municipality, and the electricity department, which as a trading concern, should be conducted on commercial lines. It is also asserted at times that the difficulty of finding the necessary money is a reason for withholding expenditure on such developments which would in normal times be agreed upon. It is probable, however, that money can be obtained by municipalities more easily for electricity supply development than by any other bodies.

The electricity undertaking of a local authority, when it has been developed on sound business lines, is often one of the best assets which that authority possesses, and no municipality having rights to supply electricity should hesitate to develop its undertaking on broad lines. As nowadays, more so than in the past, every town in itself may be considered a large commercial undertaking, competing with other towns, those municipalities which neglect to realise the importance of electricity supply development on the right lines will suffer in the great competition which is ahead of us.

On account of better transport facilities nowadays, and due to the fact that publicly supplied electricity is now generally used by manufacturers who previously had to depend upon their own power plant, industrial concerns are independent of any particular district for their works, and we see a kind of game of "General Post" going on, with the difference, however, that in this case there may be more seats than players. Those towns, which may be likened to the seats, which may find themselves empty, will only have themselves to blame, if they have not shown an attractive front to the industrial concerns when the right moment comes along.

It is of little use for municipalities to say that they will develop their undertakings after demands have arisen. They must create the demands by seeing to it that they have ample electricity supplies ready and available in anticipation of requirements.

Successful development does not come by itself, but only follows continued and increasing effort and outlay of money. It is quite useless to expect an undertaking which has reached successfully a certain stage in development to go on increasing its revenues without increasing the amount spent upon administration, publicity, &c. The guide should be mainly the return made per pound of money spent per annum.

I think that if close inquiry were made as to why some undertakings have remained almost stationary so far as, for instance, the development of domestic load is concerned, while others have gone ahead so successfully, it would be found due to the hesitation of those particular authorities to expend sufficient to develop the necessary business, and their failure to realise that it is as necessary to apply the usual business principles to an electricity supply concern as it is to any other progressive business concern.

Increased output in almost every case means lower production costs, and also in itself means more electrical plant and apparatus being sold and thus cheaper apparatus. Cheaper supplies lead to yet greater demands and more installations being wired and equipped. Thus the effects of increased output of electricity are very far reaching, and tend to increase the prosperity, health, and good condition of our towns and improve the industrial conditions throughout the country. It has been clearly shown also that increased use of electricity proves a great national blessing, in that it means conservation of our coal supplies either for our own future use or for our export trade.

The country has, during the last few years, been critically examining the existing methods of generation of electricity, and has found that great improvements can be made in many directions. It has recognised that individual generation of electricity was natural enough, and the only practical procedure, so long as its use was comparatively small, but that as electricity is now a commodity of such every-day use and with such a large and general growing demand, to adhere to the original practice would in many cases bespeak obsolescence.

It has realised the great necessity for generation on a much larger scale, and to provide for greater areas and, on that account, the necessity of joint action of various supply authorities in the different districts in connection with generation and main transmission, and has shown its decisions in legislation towards those ends.

So far the divergent interests of various individual authorities have not permitted the establishment of constructive policies satisfactory to groups acting together, but now that it is realised that joint action for the generation portion of their operations can be made without prejudicing the rights or stability of their individual undertakings, and that by such joint action they can reduce the cost of supplying themselves, approved schemes for joint working will soon come into satisfactory operation in many districts throughout the country.

The public, seeing its interests properly safeguarded, can be counted on for sympathetic support towards the schemes, while industrial interests in general, being in the business of manufacturing commodities rather than electrical energy, will favour any action that will facilitate a cheaper supply of energy, which is an accessory to their operations.

The outcome of the establishment of properly co-ordinated and balanced schemes for the establishment of joint generation with common and general main transmission lines will be the tendency to equalise industrial opportunity, and I consider that we can look towards the future in the most optimistic spirit.

THE POSSIBILITIES OF FLOOD AND PROJECTOR LIGHTING.

By F. A. P.

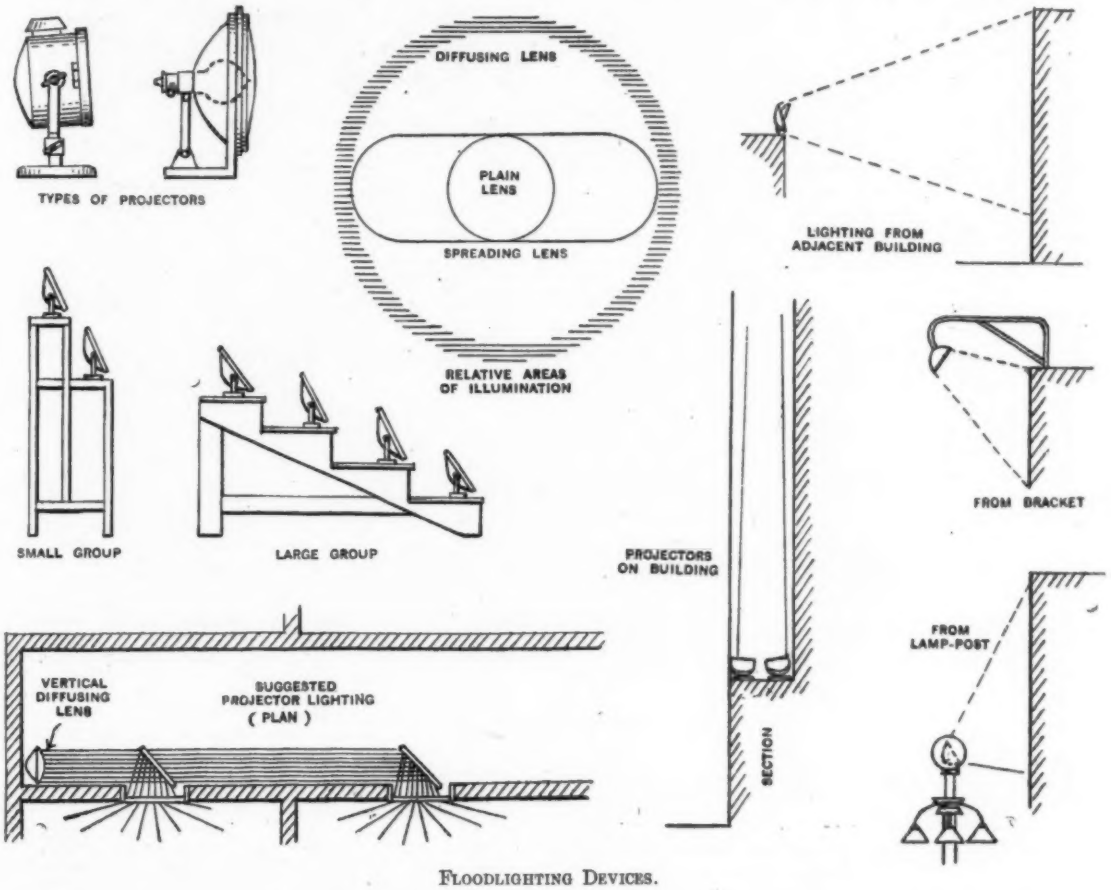
The general use of the searchlight in the early days of the war no doubt brought into prominence the possibilities of the illumination of buildings by light projected from a distance, the advance of the half-watt type lamp, with its small light source, about this time greatly assisting in making the scheme a commercial proposition. As no external light was permissible here, the scheme was developed in America and has been most thoroughly worked out, and is now making headway in this country.

It was originally confined to the lighting of buildings for advertising and other purposes, but has now much wider uses, such as the lighting of yards, &c., so that work can be continued after dark.

The projectors now in ordinary use, though based on the searchlight principle, are naturally much smaller and shallower in construction, owing to the much shorter range and less powerful beam required and the metal-filament lamp employed, the function of the searchlight being somewhat different. The military searchlight had to send a concentrated, almost parallel beam of light to considerable distances, and for this reason contained a powerful arc, the carbons being arranged horizontally with the end of the negative carbon or brightest part at the focus of the parabolic reflector, thus influencing the design of the body.

Floodlight projectors are required to illuminate larger surfaces from a comparatively short distance, and one or two types, fitted with tungsten lamps, are shown in the above illustrations. The bodies are usually capable of being swivelled, preferably in all directions, and the position of the incandescent lamp is made adjustable horizontally in order to get it in the focus of the reflector when desired. The sizes usually made vary from 9 in. to 16 in., but more powerful projectors can also be obtained, and the angle of divergence of the beam varies from 6° to 20°, according to the spread of light required.

For a long range, say from 500 to 2,000 ft., a highly-concentrated beam of small divergence is required, and a lamp of the half-watt type, with a small light source, is used. For shorter distances, say up to 1,000 ft., a divergence of 20° could be used, and a lamp with a larger filament is permissible. For short distances and greater surfaces, projectors can be fitted with spreading or diffusing lenses. Usually a disk of light about 10 ft. diameter would be obtained from a small projector of, say, 6° divergence at 100 ft. range with a plain lens, or 18 ft. diameter with 10° divergence, and 36 ft. diameter with 20° divergence, but this depends also on the size of the filament used, its position with regard to the focus of the reflector and the shape of the latter, which is not always a true parabola. The spreading lens enables the light to be spread in oval form instead of circular, the length being from three to four times the height, while the diffusing lens enlarges the disk of light from three to four times in diameter.



Floodlighting Devices.

Flood lighting has many uses, such as the illumination of the fronts of buildings for advertising purposes, and of public buildings on special occasions; lighting up large posters and signs; for battery rooms or places where acid fumes are deleterious to wiring; for use in shipyards and decks, railway and works yards where labour is required after dark; lighting buildings during progress; for swimming pools, open-air sports grounds, and, in general, open spaces where a system of lamp-posts has not already been installed.

For lighting buildings the power required varies from ¼ to 5 watts per sq. ft. of surface to be illuminated, according to the colour of the brick or stone; a very light painted front would require only about ¼ watt, a red brick building 2 watts, and a very dark building 5 watts per sq. ft. The flood light projector being easily handled, it is easy to determine experimentally the required amount of light, by trying the effect of, say, one projector of about 1 watt per sq. ft. capacity on a portion of the building, and if this is insufficient training two projectors on the same spot. The best position to place the projectors is on adjacent buildings, as the light is more uniformly distributed, and heavy shadows from projecting portions of the front are avoided, but quite good effects have been produced by lamps placed on the building itself, either on brackets at the top or preferably on the first-floor level if the upper portion of the building is set back from the ground-floor level. The projectors on some large buildings in London are only about a foot or two in front of the actual upper-floor frontage, yet when fitted with deflectors the effect is quite good. For close-up work projectors are not absolutely essential, angle reflectors being sometimes used. The lamp-posts in the adjacent street have also been used for mounting flood lights.

As instances of the amount of light required, a building of 2,500 sq. ft. frontage has been lit by 10 projectors of 250-watts capacity each, the cost for four hours daily lighting, excepting Sunday, being only £1 per week, assuming electricity at fourpence a unit, while the Statue of Liberty in New York harbour has 15 batteries totalling 246 units of 250 watts each.

As methods of lighting improve, and the cost of producing artificial illumination decreases, so the brilliancy of our lighting increases. Where a single candle sufficed at one time, one hundred times the candle power is commonly used without reaching the standard of daylight. The lighting of streets and open spaces now receives much greater attention than formerly, and flood lighting will probably be much used in the future for this purpose, not only on account of the uniformity of lighting which can be obtained, but probably also on account of the saving to be effected in reducing the number of cables and lamp standards. Lengths of sea front have already been lit in this way from one or more points, and it is obvious that stretches far beyond the limit of the existing lamp-posts can be effectually lighted without the necessity of extending the cables.

Works have been flooded with light in order to guard against burglary, and this system might also be used for the grounds of country houses for occasional use both for protection and for special occasions.

It is conceivable that a system of projector lighting may be adapted to inside lighting. There is quite a field for experiment here which is apparently untouched, the lighting of rooms from banks of lamps in skylights and window frames with diffusing fronts being hardly in the same category.

It might be worth while trying the effect of a central supply of light from a projector and reflecting the light through the fanlights of rooms. The loss of light by the double reflections in the parabolic reflector of the projector and the fanlight reflector and the loss in the diffuser, which might also be required, assuming in each case an efficiency of, say, 70 per cent., which has been obtained in high-class work, would give an overall efficiency of over 34 per cent. This would not be less than that obtained in indirect lighting, and a saving in installation costs might be possible by this means.

Canadian Exhibition Train for France.—It is the intention of the Canadian Government to send an exhibition train through France this year. An item of 50,000 dollars to cover the cost of the train has been approved by the House of Commons. Both agricultural and industrial exhibits will be shown, and it is expected that Canadian manufacturers will aid in outfitting and defraying the cost of the train.—*Reuter's Trade Service* (Ottawa).

THE MANCHESTER ELECTRICITY UNDERTAKING.

ANNUAL REPORT AND ACCOUNTS.

We have received from the chief engineer and manager of the City of Manchester electricity undertaking (Mr. S. L. Pearce) a copy of the annual report and accounts of his department for the year ended March 31st last.

Although the financial result was not so good as that of the previous year, having regard to the difficulties by which undertakings of this nature were beset during 1921, it must be considered very satisfactory.

The total revenue received amounted to £1,429,995, as compared with £1,547,226 in 1920-21, the decrease being attributable to a considerable reduction in the sales of energy. The working expenses, however, also showed a decrease, the figure being £977,102, as against £1,115,239. Apart from the diminished output, the fall in the price of fuel helped to lower generating costs; the fuel costs fell from £568,330 to £440,101. An increase in salary charges was practically balanced by decreases in wages. Repairs and maintenance costs were slightly less than in the previous year. Management expenses remained at about the same level, but on the expenditure side an additional item appeared, viz., £2,313 as preliminary expenses in connection with the new Barton station. Rates charged against revenue increased by £20,731 to £107,105. Distribution costs, £169,969, were £13,132 lower than in 1920-21. The gross profit amounted to £452,893, as compared with £431,987. The charges against this, with the exception of income tax, all showed increases, the principal being an addition of £30,929 on account of interest on mortgage debt and deposits, and bank interest, which totalled £134,044. The total charges amounted to £408,776, and crediting interest on stock, £447; the net profit was £44,564, as against £69,123 in the previous year. The whole of this amount was transferred to reserve account; last year an amount of £37,230 was contributed in aid of the rates. The balances at the credit of the various accounts, carried forward, are: Sinking fund account (after redeeming mortgages to the extent of £170,830), £8,840; renewals suspense account, £202,589; reserve account, £127,327.

The total capital expenditure during the year was £1,458,353, making the total spent up to date £5,607,698. The principal items were £678,848 on the Barton station, £152,705 on the Stuart Street station, £122,537 on distributing stations, £445,258 on mains (including £333,691 on 33,000-V extensions), and £16,946 on services. Over-expenditure on capital account amounts to £127,420.

Turning to the production of the undertaking, the report shows that the energy generated amounted to 213,336,210 units, as compared with 256,656,070 in the previous period. The quantity sold was 158,489,732 units, a decrease of over 20 per cent. The decrease occurred wholly in the supply to private consumers, which fell from 167,019,709 to 124,790,558 units. Public lighting made a greatly-increased demand, and the traction supply also showed a small increase. The maximum demand decreased, the figure being 83,550 kW, as against 89,500 kW. Here again lighting and power caused the decrease, the traction demand being slightly higher.

The department's borrowing powers were increased during the year by £2,173,466, of which amount £1,816,743 was the balance in respect of the construction of the Barton station and h.p. transmission mains. The installation of two Babcock & Wilcox boilers, each of 80,000 lb. evaporative capacity, at Stuart Street, was completed. An 8,000-kW turbo-alternator, with condensing plant, was also installed at this station, bringing the total capacity of the plant up to 100,250 kW, based on the most economical rating. The maximum steaming capacity is equivalent to 85,000 kW, and the station is believed to be the largest *single* station in this country. No further additions are to be made to this station.

Owing to the satisfactory state of the department's coal stocks, to a limited conversion of boilers for oil fuel, and to purchases of American and Dominion coal, the undertaking not only maintained the supply of electricity throughout the period of the coal dispute, but also aided other departments. There has been a marked improvement in the quality of the coal received at the generating stations, and this has brought about a substantial reduction in consumption.

Fair progress was made during the year with the Barton buildings, but the erection of the plant is likely to be delayed as a result of the engineering lock-out. In connection with the Barton station a number of contracts for valves, pipework, pumps, &c., have been placed. Important extensions have been carried out during the year at several distributing stations. 1,500-kW motor converters have been installed at Sherborne Street (one), Withy Grove (one), and Moss Side (two). A distribution station has been established at Knott Mill, with an aggregate capacity of 4,500 kW, in connection with the supply to the Deansgate area. Alternating current stations were established at Failsworth, Blackley Estate, Gorton Estate, Wilbraham Road Estate, Anson Estate, Catterick Hall Estate, Clayton Estate, and Newton Heath Estate. Additions to the extent of 2,000 kW have been made to five existing private sub-stations, and four new stations have been established, these having an aggregate

capacity of 3,250 kW. An addition of over 50 miles was made to the mains system during the year. Messrs. Callenders have completed about 77 per cent. of their 33,000-V cable contract in connection with the Barton supply, and Messrs. W. T. Glover & Son, Ltd., have laid the new Failsworth cables.

Considerable progress has been made in the lighting of the new housing estates, and several main streets have been connected to the mains for public lighting.

AN ECHO OF THE JOHANNESBURG STRIKE.

Under the above title we inserted some information as to the way the power and lighting services were maintained during the recent Rand strike, sent to us by Mr. B. Sankey, the general manager of the Johannesburg municipal electricity undertaking. Through Mr. Sankey's further kindness, we are now able to reproduce some photographs taken during the dispute. The group in fig. 1 is composed of the staff and volunteers who carried on the supply undertaking for some time. These volunteers were principally members of scientific and technical societies, and it did not take them long to get into the way of things at the station. The numbers at the feet of some of those in the front row indicate: (1) Mr. N. O. Currie (C. A. Parsons & Co); (2) Sir Spencer Lister; (3) Dr. J. Orenstein (President of the Technical Societies' Executive); (4) Mr. Bernard Sankey; (5) Mr. H. Reynolds (Babcock & Wilcox); and (6) Professor Dobson (late general manager of the electricity undertaking). Those at the back are seated upon a "whippet" tank employed against the strikers. Quite an "active service" atmosphere is present in the two smaller photographs. Fig. 2 shows "H.M.L.S. Union," referred to above, and the inspection of rifles preparatory to going into action. The third photograph shows the armoured car "Otazell," manned by irregular troops holding a flag captured from the strikers. In the foreground an "orderly" is seen carrying the bread supply into the station.

Fig. 1.—Staff and Volunteers at Johannesburg Power Station.

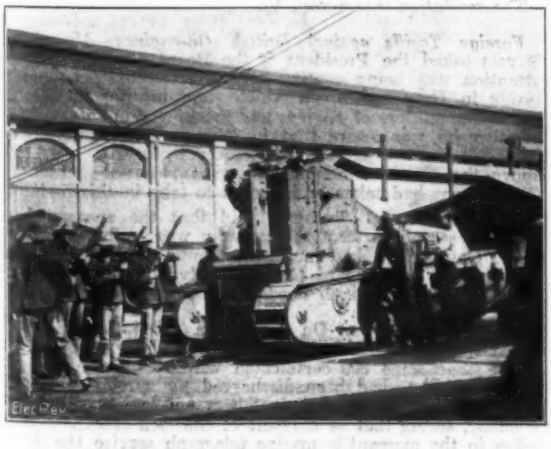


Fig. 2.—Whippet Tank used against Strikers.

Fig. 3.—Armoured Car and Bread Supply.

PARLIAMENTARY NOTES.

[FROM OUR SPECIAL PARLIAMENTARY REPORTER.]

L.C.C. Tramways.—During the debate on the L.C.C. (Money) Bill, on June 15th, expenditure on the L.C.C. Tramways was much criticised. Mr. Rawlinson said that there was an item in the Bill for the purchase of tramway undertakings, construction, reconstruction, and equipment of tramways, provision of buildings, power stations, machinery, rolling stock, and for other purposes, at a cost of £1,000,000. Then there was a subsequent sum of £127,000. From what he remembered this meant that the L.C.C. bought up the London United Tramways, and that £1,000,000 was the cost of buying it up. Had the company for some years been earning any profit? If it was run at a loss, why should the L.C.C. spend the ratepayers' money on an enterprise which no business man would put money into?

MAJOR GRAY, in reply, defended the tramway system, and said that there was only one new line for which provision was made, and that was for a sum of £35,000. The £1,000,000 which had been referred to by Mr. Rawlinson included £235,000 in respect of the purchase of the London United Tramways. The L.C.C. was bound to carry out that purchase because the contract for it was made before the war, and it had merely been postponed. The whole of the remainder of the £1,000,000 was to be spent on generating plant, new cars, and general purchases for carrying on the undertaking effectively. During the war all expenditure was restricted, and there was now a large amount of leeway to make up. Having regard to the great extent of the tramway system, he thought it was not unreasonable to ask for something like £600,000 for such work as the generation of electricity and the provision of new cars, which had now become absolutely essential to enable the L.C.C. to increase its car mileage. He prophesied that in a few years London would have the largest system of tramways in England, and he believed that the present system would justify itself if given time.

Wireless Telegraphy and Signalling.—Mr. KELLAWAY, the Postmaster-General, in moving the Second Reading of the Wireless Telegraphy and Signalling Bill on June 16th, said that some form of control was necessary in connection with the progress of wireless telegraphy and telephony. In the United States a condition of chaos had arisen from the lack of Government control, and the American Government had been making very drastic proposals to remedy this state of things. The present Bill contained the proposals laid down in the Act of 1904, and also made a number of new proposals which were found to be necessary. The steps to be taken had been considered by an inter-Departmental Committee, consisting of representatives of the Post Office, the Air Ministry, the Admiralty, the War Office—all the Government departments interested in the use of wireless. The Bill did not propose in any way to withdraw from the public the advantages of wireless communication. On the contrary, its effect would be, by ensuring the proper use of wireless, to assist its development. The Bill left full scope to inventive genius by allowing the erection of experimental stations in proper hands. At present some 9,500 receiving licences had been issued, and 400 licences for transmission.

The conditions under which the broadcasting of wireless telephony would be worked had not yet been decided. He did not think it desirable that the work should be carried on by the Government. A meeting was taking place that day at the Post Office between the firms interested and the Post Office officials, as a result of which he hoped some agreement would be reached.

The most interesting provision of the Bill was that which applied to wireless in aircraft. Another provision dealt with the position of the Dominions. Hitherto he had so far controlled the use of wireless in ships, registered in the Dominions, on the high seas, but as the self-governing Dominions now possessed the necessary legal powers of control, the Colonial Office thought that the power which had been reserved to the Postmaster-General should be abrogated.

The Bill was read a second time.

The Telephone Service.—On the same day Mr. Kellaway, in moving a resolution authorising the issue out of the Consolidated Fund of such sums, not exceeding in all £15,000,000, as were required for the further development of the telephone system, said that this sum would last, it was estimated, until the end of April, 1924. He said that, owing to the war, it was not until the beginning of 1919 that the Engineering Department of the Post Office was able to devote its attention to the development of the system. Development was necessary if this country was to remove the reproach of being far behind every other principal country in this respect. In 1919-20 £3,230,000 was allocated out of telephone capital for the development of trunk lines, exchanges, &c., of which amount £2,647,000 was actually spent. In 1920-21, out of a proposed expenditure of £6,884,000, £5,866,000 was spent, while last year, out of £9,032,000, £7,438,000 was spent. For the present financial year the proposed capital expenditure amounted to £9,250,000, of which sum £2,760,000 was for the provision of new trunk lines and the completion of trunk lines now under construction. A sum of £5,740,000 was for new exchanges and the extension and improvement of existing exchanges, and £750,000 for sites and buildings. The main object was that the whole of the trunk lines in this country should be placed underground, the advantage of which would be enormous. There was also included in this year's programme an amount of £504,000 for new underground cables. This included two long routes from Leeds to Edinburgh, and from Worcester to Bristol. The former would complete the provision of the main routes for underground communication between London and the North of England and Scotland, while the latter would complete the underground means of communication between Birmingham, Bristol, and South Wales. Then there was an item of £1,537,000 for the provision of new, and the extension of existing, switchboards. With regard to relief exchanges, seven were proposed in outer London. New permanent exchanges would shortly be opened at Tottenham, Barnet, Sydenham, and Wembley. In the Provinces it was proposed to provide about twenty new exchanges, while about thirty of the more important exchanges would be extended.

There was still a very heavy programme of building work to be carried out in the near future owing to the exhaustion of the space at many exchanges. He had had repeated representations made to him as to the inadequacy of many existing post office buildings. During the current year it was proposed to acquire sites for three new exchanges in the centre of London, about fifteen in the suburbs, and about ninety in the Provinces, including Scotland and Wales. It was proposed to begin building work in connection with about twenty-five exchanges in London and about eighty new or enlarged exchanges in the Provinces. There still remained certain areas where, owing to the shortage of plant, would-be subscribers could not be connected. Estimates had been secured for a programme of work for the next five years which amounted to £35,700,000. The three considerations to be kept in view in arriving at that figure were the rate of development, the level of prices, both for labour and material, and the extent to which the automatic system would be introduced. The automatic system would not solve all their telephone troubles. The head of the telephone system in the United States had told him that in the United States the pressure for the automatic system did not come from the subscribers, but from the companies, which saw in the automatic system the means by which they could get over their operating difficulties at a smaller operating charge. Until such time as they could see a workable and reliable automatic system which could be installed on much more reasonable terms than any hitherto offered he did not feel justified in incurring the expenditure. The development programme was based on an estimated cumulative growth of 8½ per cent. per annum, which was the actual work of extension in 1920-21. On April 1st this year there were 975,000 telephones in the country, and 8½ per cent. yearly extension would give 1,466,000 in 1927. Compared with the use of the telephone in America that was a miserable figure, and he hoped for very much better things. There had been a loss of subscribers owing to the increased charges, but that reduction was far smaller than was anticipated.

The resolution was agreed to.

Foreign Tariffs against British Oil-engines.—Mr. A. T. DAVIES asked the President of the Board of Trade whether attention was being continuously directed to the enhanced tariffs in Italy and Spain which were injuriously affecting the manufacturers of engines and machinery in this country; whether he was aware that in Italy tariffs against British-made oil engines had been increased by over 20 per cent. above the pre-war amount; and what practical action the Government had taken or intended to take in this matter?

Sir W. MITCHELL THOMSON said that the answer to the first and second parts of the question was in the affirmative. H.M. Government had made representations to the Italian Government with regard to the greatly-increased duties now levied on certain British goods (including oil engines).

Wireless Watchers.—On June 15th Lieut.-Colonel HURST asked the President of the Board of Trade whether he was aware that some 800 certificated wireless operators, mostly ex-service men, had been discharged by wireless companies since the institution of watchers on cargo ships; and whether, seeing that as a result of the lack of expert knowledge in the mercantile marine telegraph service the danger of failing to notice distress calls had been enhanced, and such failure was one of the causes of the loss both of the ss. *Rowan* and of the Peninsular and Oriental liner *Egypt*, he would consider the desirability of abolishing wireless watchers in the mercantile marine and of re-employing certificated operators in their stead?

Sir W. Mitchell Thomson said that he was aware that there was unemployment among wireless operators, but the main cause was the general depression of shipping, which affected all classes of officers and men of the mercantile marine. Pending the results of the Court of Inquiry which was being held into the loss of the ss. *Egypt*, he was not in a position to say whether there was any failure in the wireless service on that occasion.

Telegraphs in Palestine.—Sir William Joynson-Hicks asked the Secretary of State for the Colonies to state the cost of reconstructing the telegraph and telephone systems in Palestine; and what, if anything, the Palestine Government had paid for it?

Mr. Churchill said that he was unable to give figures as to the cost of reconstruction. The whole system, with a few minor exceptions, was handed over by the military authorities to the Palestine Government on October 1st, 1920. The value of the works so transferred had been provisionally agreed between the two parties at £30,000; and this amount, or the revised amount finally determined, would be treated as part of the capital debt of Palestine to H.M. Government.

Insulators for India.—Colonel Wedgwood asked the Under-Secretary of State for India whether any contract for insulators had recently been given out; if so, had the order been given to firms in this country; and, if not, when it was expected that this order would be placed?

The Earl of Winterton said that he was informed by the High Commissioner for India, who controlled such purchases for the Government of India, that no contract had recently been made by him for the supply of insulators. He had, however, tenders now in hand for a supply of these articles, and found that the lowest acceptable offer (having regard to price, delivery and other relevant considerations) was that of a firm in this country for insulators of German manufacture. The contract was about to be placed accordingly.

Dutch Electric Glow Lamps.—Replying to a question by Mr. Hancock, Mr. Baldwin said that he was unable to state the numbers of half-watt type lamps bought in Holland by British dealers in 1920 and 1921. The imports into the United Kingdom of electric glow lamps, gasfilled, consigned from the Netherlands, were as follows:

	Number.	Value.
1920	40,392 ...	£5,359
1921	780,533 ...	92,387

Torquay Corporation Bill.—On June 19th, the Torquay Corporation (Electricity) Bill, which has already passed through the House of Lords, was read a second time in the House of Commons.

The Erith Scheme.—Mr. Gilbert asked the Parliamentary Secretary to the Ministry of Transport, whether the representatives of the West Kent Electricity Co., whose application for permission to erect a capital generating station at Erith was now before the Electricity Commissioners, had an interview with the Commissioners on the subject towards the end of last or the beginning of this year; whether the interview was an official or private one; if shorthand notes of the proceedings were taken; and if it was the custom of the Commissioners to grant such interviews to all applicants who had to appear before them at public inquiries?

Mr. Arthur Neal replied that he understood that the Electricity Commissioners had had more than one interview with representatives of the company. Those interviews were of a semi-official nature and shorthand notes were not taken. It was the custom of the Commissioners to grant interviews if by so doing they could advance the public interest.

The Wrexham Undertaking.—Mr. Gilbert asked whether the Wrexham Corporation had applied for consent to extend its generating station; whether the Electricity Commissioners had refused to sanction such extension, and had called upon the Corporation to take what further power it required from the North Wales Power Co.; whether the latter company had quoted a price of £6 a kW. and .75d. a unit, which was the maximum price which it was allowed to charge; and whether, in view of the attitude taken up by the power company in the matter, the Commissioners proposed to reconsider their decision to withhold consent to the extension of the Wrexham undertaking.

Mr. Neal said that the hon. member had been misinformed. The consent asked for by the Wrexham Corporation was granted by the Electricity Commissioners. He understood, however, that the Corporation subsequently decided to obtain a bulk supply, and was in negotiation with the company.

United States Output of Aluminium.—The Geological Survey announces that the value of aluminium produced in the United States last year was $10,906,000, while the 1920 output was worth $41,375,000. This great decrease was due not only to a drop in the price of the metal but to the curtailment of its use in automobile industries. Imports of semi-manufactured aluminium in 1921 were 32,665,300 pounds, compared with 39,298,650 pounds in 1920. Exports of aluminium in 1921 were 2,196,100 pounds, as compared with 9,407,650 pounds in 1920.—*Reuter's Trade Service* (Washington).

LEGAL.

Prosecutions for Improper Use of Electricity.

At Southend, on June 2nd, the Borough Council prosecuted in two cases of the improper use of electricity.

In the first case the defendants were Messrs. P. Morgan and Co., motor engineers. It was stated that a meter reader inspecting the firm's electrical installation discovered that the current limiter, installed under a contract, had been short-circuited by a steel pin, enabling the defendants to obtain as much energy as they required. No evidence was put forward showing that additional apparatus had been connected, nor that any fraud had been committed. For the defence, it was asserted that on a previous occasion one of the firm's employés considered the lighting insufficient and inserted the steel pin referred to in the current limiter. It was forgotten and when the firm discovered it, it disclaimed responsibility. The magistrates, in fining the defendants £5, said that greater care should have been exercised in the inspection of their premises by the employers, and they were certainly responsible for what had occurred, although, no doubt, it was done without their knowledge.

The second charge was against Harry Goldstein, of Westcliff. In this case it was alleged that a meter reader, after completing a reading, found an electric radiator upon another circuit. Wires had been taken from a spare fuse box which had been used by a previous occupier. The wires from this should have been sealed, but it was found that they had been connected to a switch and another circuit, the result being that defendant was obtaining electricity without payment. The seals on the spare cut-out had been broken off. The defendant said that the work had been carried out by a man named Dunmore, who, when questioned, said that it was not his business to see that there was a meter in the circuit. Dunmore, under examination, said that he fixed the radiator but did not notice that the meter was not registering the electricity taken. Asked why he had not applied to the Corporation for permission to connect the radiator, witness said that it was not necessary, as no new wiring was involved; the appliance was on a lighting circuit. The defendant's solicitor said that his client admitted obtaining electricity improperly, but without guilty knowledge. He therefore asked that the charge should be confined to obtaining electricity improperly. This was agreed to, and the magistrates fined defendant £5, with £5 5s. costs.

Edison Swan Electric Co., Ltd., *v.* Jones & Pordes.

Application was made to the Lord Chief Justice and Justices Bailhache and Salter in the King's Bench Divisional Court on June 15th by the plaintiffs that defendants should find security for costs in an appeal which they were bringing against a judgment of the County Court Judge of Clerkenwell.

Counsel appearing for the applicants explained that his clients obtained judgment against Messrs. Jones & Pordes in respect of an account for electric lamps supplied. Messrs. Jones & Pordes now desired to appeal, although in his opinion they had no point of law to raise, and his application was that they should be ordered to find security for the costs of the appeal, because his information was that they had not sufficient assets to meet the costs if the application failed. Counsel added that the goods were supplied to Jones & Pordes in partnership, but since then the business had been turned into a limited liability company with a capital of £1,000.

Counsel for Messrs. Jones & Pordes emphatically repudiated the suggestion that his clients were unable to find the costs of an appeal. With an increasing business, he said, his clients were in a very favourable position and well able to meet any demands for costs. His case was that there was a good point of law to be argued; in fact, the County Court Judge willingly gave them leave to appeal.

The Court ordered that Messrs. Jones & Pordes should deposit £15 in Court as security within 14 days.

Insulated Annealed Copper Conductors.—The British Engineering Standards Association has published a revised edition (No. 7, 1922) of the specification for dimensions of insulated annealed copper conductors for electric power and light. This contains all the information relating to sizes, tests, standard dielectric thicknesses, &c., given in the July, 1919, edition, with the addition of a new size of cable 0.03 sq. in. in area. Standard thicknesses for cab tire sheathing have also been incorporated. A metric edition of this specification (No. 152, 1922) has also been issued. This includes all the recent modifications to the original specification. One additional size of cable (1.5 sq. mm.) has been included; this is a size commonly employed in countries using the metric system. Copies of these specifications may be obtained from the Association's offices, 28, Victoria Street, S.W.1, price 1s. 2d. each, post free.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Mangnall-Irving Thrust Borer.

May I be permitted to reply to those of your readers who disagreed with my letter concerning the above device, which appeared in your issue of May 15th?

In the first place your correspondents have not grasped the main point of my letter, which I think is made clear in the last few lines, viz.: "I fail to see that this method can appreciably reduce, much less eliminate, the trenching, &c., that is a necessary part of present day cable laying."

I do not object to the word "improved," but I thought that the title "improved method of cable laying" was somewhat misleading, as the article in question states that "the object of this machine is to eliminate trenching."

Does it eliminate trenching? This is the point concerning which I had my doubts.

I quite agree that the thrust-borer may be of great value in special cases and under certain circumstances.

All those who have taken exception to my letter quote "special cases," but nobody gives a single instance of any long length of cable laid by this method.

Mr. E. Ll. Ingram gives some figures where the thrust-borer shows a very great saving, but even he admits that his example is a "particular case."

The question as to what depth is necessary to render unprotected cables safe from external mechanical damage is a very debatable point, but I, personally, cannot agree that another foot or eighteen inches depth affords more protection than a warning board.

Mr. A. R. Porter draws my attention to experiments carried out with key fibre conduit. These are of interest, but they constitute a special case, *i.e.*, short runs in the case of services.

Mr. A. R. Mangnall advises that I should get in touch with the mains engineer of my own town—Sheffield.

As I have only been in Sheffield for about six months it is not surprising that I was unaware that a thrust-borer was in constant use. However, during that six months I have seen trenching being opened for cables and have also seen one side of a very busy main thoroughfare opened up to lay cable by means of trenching—incidentally, I have also seen earthenware pipes for carrying cable being laid in trenches.

As one who is interested in "mains work," I should welcome the introduction of some method which would eliminate trenching, but I cannot see that the thrust-borer achieves this object except in certain cases and under certain conditions. In towns, and it is in "towns" where main laying is going on all the year round, the available space for cables under footpaths and pavements is limited, due to gas mains and services, water services, electric cables, telephone cables, drains, &c.—the danger of damaging any of these may be considerable unless boring is carried out below these obstacles, say, at a depth of 4 or 5 feet. If this is done, the ground will have to be opened to this extra depth for all service connections (in the case of a distributor) and for anything in the way of a fault—whilst should it ever become necessary to take out the distributor, trenching to this extra depth would have to be resorted to except where the bore had been made in ideal soil such as hard clay.

For street crossings, &c., I should think boring is an excellent method provided obstacles are all missed, and in any case it is no doubt much cheaper.

My letter was not written to raise a controversy, but I hoped it would be the means of eliciting information through the columns of the ELECTRICAL REVIEW on a point on which I had doubts, and which information would be of interest to other engineers as well as to myself.

F. O. Trotman.

Sheffield, *June 19th*, 1922.

Where are the Young Men of the I.E.E.?

I noticed a rather surprising thing at the Scotch meeting of the I.E.E.: the comparative absence of the younger generation (if I may apply the term without offence to anyone). Here was a splendidly organised affair of not only deep technical interest, but also of real recreative and social value; yet the number of fellows in the twenties and early thirties could almost be counted on one's fingers. Why was this? One member with whom I discussed the matter considered that the party was better off without them, as they "tended to be too serious." I think this is an unfair view, especially as the trend of most conversations was (inevitably!) "shop." No, I cannot concur in such an attitude. I do feel that the younger generation of the I.E.E. should have been better represented.

Of course, there are reasons to account for the scanty number, and I imagine that one is that if a holiday is to be had then it should be a real holiday. Unless a young chap is exceptionally fortunate enough to have a long holiday at his disposal, he naturally looks askance at an outing, however brief and however sketchy its technical side, which smacks of his daily work. I think this reason tends to weigh more with young folk than it does with older people.

Then there is the tremendous item of expense. The average young engineer, if married, simply cannot afford to attend a function like the summer meeting; and if not married, probably aspires to be, and for that reason the thrift which a generous profession enforces has to be raised to the *n*th power.

And yet, though one could see clearly why the "young 'uns" were conspicuous by their rarity, it was still disappointing to meet so few. Out of so large an Institution one would expect quite a lot of exceptions—fortunate or daring fellows to whom the above damper reasons would not apply.

In the belief that what I point out may be somewhat of an "eye-opener" to many who felt too dubious to join the I.E.E. Summer Meeting, I feel impelled to say that it was by no means a cheerless affair, with a technical atmosphere which froze one's joviality. Quite the contrary! Although there were power stations and works visits (and a couple of lectures thrown in) these did not preponderate at all, and I, who joined the party prepared to find this the case, was pleasurably surprised by the actuality. Indeed, although the meeting was of immense educational value one absorbed things in so interesting and free-and-easy a manner that it seems a pity to bring in so severe a word as "education"; and my chief recollection is of thoroughly enjoyable chats, luncheons (I see my Scotch friends' eyes twinkle at this), dances, and above all the glorious highlands. And the organisation of the whole affair was splendid. As one who has tried his hand (and patience) at the social side of a large club, most humbly do I pay my respects to the organisers.

So, then, let us hope for better support from the young people of the I.E.E. I have an idea that a few prizes as *entrées* to summer meetings and the like would be an encouragement, especially to needy fellows—and there are some in the Institution. Anyway, I hope that next time I won't find myself one of so pronounced a minority!

G. E. Moore.

Newcastle-on-Tyne, *June 17th*, 1922.

Armature Windings.

Having built a few small dynamos of from ¼ to ¾ kW output, I should like information on one detail from any competent correspondent who may feel inclined to give it—I refer to the armature winding.

Never having been in a dynamo manufacturing shop, I have followed my own ideas, and have used three kinds of winding—hand wound, and former wound coils of two types, viz., Eickmeyer coils with end connections running across the core, and "barrel" winding with end connections lying on a barrel or drum, similar to multipolar machines. (It must be pointed out that this question refers to bipolar machines only, and to open rectangular slots.)

What are the respective merits of the three methods? To my untutored mind hand winding is not in it at all, former winding being balanced electrically and mechanically, and in my case taking less time.

Of the two methods of former winding, the first must result in a shorter machine, while the second seems more accessible, but has longer end connections.

Ignoramus.

June 19th, 1922.

State Salary Required.

Under the above heading in your June 9th issue, I think "A.M.I.E.E., &c.," has hit at a cause of great trouble to real men when they apply for a vacancy and are asked to "state salary required." In my opinion it's a 10-1 chance that the man who asks the least gets the job, although he does not undervalue his services because really they are worth nil, if he is prepared to take on a job worth £10 a week for 50s. or 60s., and trust to the balance sheet for more.

I know of a vacancy for a manager filled by a man who had never been in that particular line, but I suppose he asked the least. Now what happens in such cases is:

1. They are entirely under the thumb of the directors, who generally know about as much as they do, for had they been keen business men and known the trade they would have never made the appointment.

2. The manager looks round and finds good men in the works getting more than he is and so he starts cutting down expenses, in other words, wages of men who know the trade, and so one more firm starts on the road to the Bankruptcy Court.

Forward.

June 12th, 1922.

In the electrical, like every other business, it seems to be a habit with a great many employers, when advertising a vacant post, to stipulate "state salary required." This simply means that some poor individual who is "down and out" receives the situation; as naturally in his anxiety to get employment he offers his services at a small salary. Surely the above-mentioned employers know what they are willing to pay, and it would be an easy matter to state exactly the

remuneration attached to the vacant posts. The writer has no Bolshevik tendencies, but would say that if a great number of our British employers assumed a sense of fairness they would have the admiration instead of sneers from their more unfortunate employés.

Another Who Has Been Had.

June 19th, 1922.

More Opportunities for Business.

In this town of 35,000 inhabitants there are over 50 of those little three-wheeled trucks which are so generally used for the actual distribution of milk to its consumers. The streets are perfectly level and very smooth, and there has been a public supply of electricity for 20 years; yet all those trucks are still being pushed by hand.

Of course, if Worthing were the only town neglected and abandoned in this way, it wouldn't matter very much; civilisation and the truck-makers could hold up their heads and smile. But it is worse than this. The population in this country served by a public supply of electricity (if they have the means, mental and financial, to take advantage of it) is about 25,000,000, to supply whose milk requires some 35,000 of the milk trucks aforesaid, and *these are all pushed by hand.* At least, I deduce that they are, for of all the truck-makers I wrote to, in a recent attempt to mix electricity and milk, not one had a decent design ready, let alone a truck suitable for the work. The price of those offered varied from £450 to £300 *each*, and some of the designs were horrible abortions upon which no self-respecting milkman would allow his name to appear.

Apparently the truck-makers are content to allow electricity to push their trucks, though one would imagine that the potential demand would justify the production of a suitable light truck at from £150 to £200, even if we apply a factor of sanity of 35 to our 35,000. I know at least one dairyman waiting with his hand in his pocket for the right article; but he will not pay £300 for a ton of truck to carry 3 cwt. of man and milk.

F. R. Cripps.

Worthing, *June 19th*, 1922.

Concerted Action.

I would like to draw the attention of technical engineers to the notable victory just gained by the strongest and closest union in the world, viz., the British Medical Association. I claim that in forcing the Manchester City Council to recommend the payment of £1,700/£2,000 per annum to its health officer this Association has given a wonderful lead to other unions of technical men. It is noteworthy that there have been no fireworks—no processions—very little newspaper publicity—simply a dignified protest at the low figure offered (£1,500 per annum) and then the ban.

I would like you to ask yourselves what would happen if a similar situation arose in the appointment of an engineer. Just an undignified rush for the position without any reference to any representative body, and with very little consideration whether the position was worth more or not. And why? Bad times. Nonsense! In times of full shops and plenty there would still be the same rush for any position offering £1,500 per annum—yet engineers are quite as necessary as, perhaps more necessary to the common good than, the doctors. The reason is simple. There is no representative body to apply to. We, as technical engineers, are not strong enough to protest against low salaries—disgracefully low in many cases.

The moulders are; members of the railway unions are; and yet we consider ourselves intelligent men. Yea, even the salt of the earth—some of us.

Surely the one instance I have cited shows the necessity of getting together and giving our society the power to assert itself and to exert its power in its members' interests, as was done by the B.M.A.

The only way this can be done is by whole-hearted co-operation among technical engineers—through the medium of a society such as the Society of Technical Engineers.

Technical.

June 15th, 1922.

The Neon Lamp "Blink."

I was interested to learn, from the "Notes" column of your issue of June 9th, of the experiments carried out by Messrs. Pearson & Anson. I observed the phenomenon some time ago, and found the explanation to be quite simple.

In the arrangement mentioned in your "Notes" column the condenser is shunted by a neon lamp and the combination connected in series with a resistance. The lamp was found to "blink" with a constant frequency when connected to a d.c. circuit. It may be mentioned that a neon lamp (of the night-light type) is practically a non-conductor below 145 volts. Now, if the resistance in the above circuit is sufficiently high, the condenser will take an appreciable time to charge up, but no current will pass through the neon lamp until the voltage across the condenser and lamp reaches about 150. At this voltage the lamp starts to conduct and partly discharges the condenser until its voltage drops to about 145, when the lamp again becomes a non-conductor and allows the condenser to charge up again. The cycle is repeated indefinitely at a frequency depending upon the relative values of the resistance and condenser capacity. The "blink," of course, occurs each time the condenser discharges.

The same effect can be obtained by connecting a condenser and a neon lamp in series. If connected to a 220-volt d.c. circuit, the condenser receives a charging current through the lamp, producing a momentary "blink," but after a short interval the condenser will have lost part of its charge through leakage, thus increasing the p.d. across the lamp. When the condenser has lost sufficient of its charge to bring the p.d. across the lamp to about 150 volts, the lamp again conducts and allows the condenser to charge up again, and another "blink" occurs. The frequency of "blinks" can be increased by increasing the leak in the condenser, say, by connecting a high resistance across the terminals. I used a 2-m.f. condenser shunted by a strip of wet cardboard.

A few other properties of the neon lamp may be of interest:

1. The lamp can be lit up almost to full brightness from an ordinary telephone magneto.
2. It glows when the plate of an electrophorus is discharged through it.
3. It can be used to indicate when e.h.p. bus-bars are "alive" by simply fixing the lamp to the end of a wooden pole and allowing the glass bulb to touch the bars. A glow takes place at the point of contact.
4. If the lamp is rubbed by hand, or even a piece of metal, a bright glow can be seen in a dark room.
5. When a condenser is discharged through a neon lamp the discharge is not oscillating, neither is the condenser completely discharged.

These are a few of the many interesting properties of the lamp. I should not be surprised to see some developments in the future in fields other than for lighting.

T. A. Robertson.

Glasgow, *June 15th*, 1922.

Recently a reader drew attention to the continuous glow inside the bulb of a neon lamp after being switched off. I am regaled with a similar performance. My flat was wired by me on the open wire—flex and v.i.r. conductors—system. No metal tubing, excepting to satisfy I.E.E., through the walls. County of London supply, 50 cycles, 205 volts, single phase. Bedford Hill, S.W.12, locality.

In my case a frosted type lamp supplied by Messrs. Sloan Electrical Co. gives a display directly it is placed in the holder, whereas a clear glass lamp of G.E.C. type absolutely refuses to do so.

Messrs. Sloan have kindly offered to allow me one of their clear glass pattern for testing under similar conditions. Can this phenomena in any way prove that my installation is involuntarily connected with the wireless world? I have not yet defrayed the cost of a G.P.O. licence, by the way, although I am giving way to pressure by inaugurating in a week or two's time an Amateur Wireless Club for Clapham Park, Streatham, Balham, and neighbourhood. The circuit where the lamp glows is two-way controlled, approx. 10 yd. horizontal run. It will not glow in any other circuit. Moreover, the glow seems to oscillate irregularly in such a manner as to suggest wireless pulsations. I shall probably try a detector telephone set to investigate further, as I may save the expense of an outdoor aerial.

J. C. Elvy.

London, W.C.2, *June 19th*, 1922.

The Cost of Living in India.

In my opinion the letter that appeared in your issue of April 7th, *re* "Living in India," calls for a statement of "*facts*," as otherwise it may prove misleading to anyone coming, or thinking of coming, to India.

It must be remembered that the European population of India (like all other countries) contains all sorts and conditions. I am the senior assistant in the Calcutta office of a well-known British manufacturing firm, and as such, one of the very many now in, and coming to, India. With 20 years' experience of the country, it can be assumed that I am more or less *au fait* with what I am writing about, and the figures I give below are absolutely the minimum.

Of course, if a man comes to India, as many do, to the jute mills, &c., where I believe he receives free quarters, usually furnished, free use of a club, tennis courts, &c., Rs.500 per month in his case would be equivalent to Rs.1,200 in mine.

In 1900 it was possible to live up country on Rs.250 per month, provided one had no rent to pay, and that one's requirements were ordinary, *i.e.*, no undue luxuries were indulged in; this, of course, applied to a single man.

At that time it was possible to obtain accommodation at hotels at such places as Lahore, Lucknow, Bombay, and Calcutta at Rs.6 per day, *i.e.*, Rs.180 per month. Double room for married couple at Rs.300 per month.

In addition, for a single man a dhobie to wash clothes and

a "boy" or personal servant (both necessities), the former at Rs.8 and the latter Rs.12 per month; for a married couple the dhobie was Rs.14, boy or bearer Rs.16, ayah Rs. 18.

Present Rates in Calcutta or Bombay:—Single man at an hotel: Rs.12 per day=Rs.360 per month; dhobie Rs.12, bearer Rs.30; total, Rs.402.

Man and wife (without children) at a boarding house: Rs.600; dhobie Rs.18, bearer Rs.40; total Rs.658.

The cheapest flat, consisting of dining and drawing rooms, with a low partition or curtain dividing them, two bedrooms and bathrooms, now lets at Rs.350 per month; servants (a minimum staff) would amount to Rs.110. Bazaar—*i.e.*, meat, fish, bread, butter, vegetables, &c.—for two persons, Rs.7 per day, Rs.210. Light, fans, and ice, Rs.30 per month. Total, Rs.700.

It should be noted that Rs.402 for a single man and Rs.658 and Rs.700 for a married couple (without children) includes *nothing* but bare necessities.

In Calcutta most Europeans live at least two miles from their office, and to walk during the hot weather is impossible; to travel by tramcar, to say quite the least of it, is unpleasant, and during the rains almost impossible. Therefore, gharri hire at a minimum of Rs.1.8 per day must be added, say Rs.37 per month. No doctor's fees (the equivalent of £1 per visit), life insurance, sending wife up to the hills (a necessity after two hot seasons on the plains), provision for home leave, holidays, recreation, amusements, drinks, tobacco, clothes (a very heavy item), or extras of any description whatsoever are added; therefore your correspondent in the issue dated April 7th, must have unusual ideas of how a Rajah lives, and he would be well advised to "look before he *jumps*" at coming out on a salary of Rs.1,000 per month if he is married.

I wonder what he would think if he had to pay £260 per annum at home for a house containing four small rooms, and no garden, this being the equivalent of Rs.350 per month; the furnishing of such a house at present costs *at least* Rs.3,500.

Calcutta, *June 1st*, 1922. **A. Ditcher.**

BUSINESS NOTES.

Bankruptcy Proceedings.—L. Brown, electrician, The Street, Frensham.—Receiving order made June 13th on creditor's petition. First meeting June 26th at 29, Russell Square, W.C. Public examination July 4th at the Guildhall, Guildford.

Thomas Green Coaton, trading as "T. G. Coaton & Co.," 16, Humberstone Road, Leicester, electrical engineer. The following are creditors:—

	£		£
Berkeley, A.	19	Necta, Ltd.	10
Bell & Bury	21	Industry & Commerce Alliance, Ltd.	12
Cranmore & Co., Ltd.	12	Bramley, J. S., & Co.	20
General Electric Co., Ltd. ...	138	Bentley, D., & Co.	20
Trevelyan & Co.	23	Gent & Co., Ltd.	24
Berry's Electric, Ltd.	37	Inland Revenue	50
B.E. Co. (London and Birmingham), Ltd.	29	Midland Dynamo Co., Ltd. ...	31
Brax, Ltd.	27	Gent & Hurley	20
Drake & Gorham Wholesale, Ltd.	343	Stevens Bros.	12
Edison Swan Electric Co., Ltd.	141	Vipan & Headly	11
English Electric and Siemens Supplies, Ltd.	307	Coaton, Mrs. E.	80
Falk, Stadelmann & Co., Ltd. ...	16	Cooper, H. T.	13
Fuller's United Electric Works...	15	Potter, Mrs.	50
Hotpoint Electric Appliance Co., Ltd.	12	Wilson, E. E.	30
Hart Accumulator Co., Ltd. ...	15	City of Leicester	16
Siemens Bros & Co., Ltd. ...	52	Lee, W. A	30
Vulcan Electric Co., Ltd. ...	35	British Thomson-Houston Co. ...	97
Swan Electrical Co., Ltd. ...	10	Driver, Harris & Co., Ltd. ...	77
		Metropolitan-Vickers, Ltd. ...	64
		Meccano, Ltd.	11
		Savory, E. W., Ltd.	17

G. J. Hogg (F. Hogg & Co.), electrical engineer, 66, Waterloo Road, Smethwick.—First meeting June 23rd at the Official Receiver's offices, Birmingham. Public examination July 7th at the Law Courts, West Bromwich.

G. M. Hallett, electrical engineer, 7, King Street, Frome.—Last day for proofs for dividend July 1st. Trustee, J. P. Emett, 18, Nicholas Street, Bristol.

R. V. Mayner, electrical engineer, late of Narrow and Wentworth Streets, Peterborough.—Last day for proofs for dividend July 7th. Trustee, J. O. Morris, Official Receiver, 5, Petty Cury, Cambridge.

John Howard Hopkins, late of 140, Wardour Street, and 57, Castellian Mansions, Maida Vale, trading as the Electrical Maintenance Co.—An application for an order of discharge was made to Mr. Registrar Francke, on June 16th, at the London Bankruptcy Court, on behalf of this bankrupt, who failed in November, 1921. Mr. Vyvyan, Official Receiver, reported that the liabilities were returned at £956, apart from two disputed claims for £5,619, in respect of which no proof of debt had been received; the assets had realised £9 19s. 1d. The applicant commenced business in July, 1918, as an electrical engineer, with a capital of £1,000, at 86, Shaftesbury Avenue, under the style of "The Electrical Maintenance Co." Mr. C. A. Hall joined him as a partner in March, 1919, and introduced £3,000 as capital. The business was removed to 140, Wardour Street in August, 1919. Owing to disagreements between the partners there was a dissolution in September, 1920, the debtor continuing the business and agreeing to pay Mr. Hall £5,000 by £500 cash down, and weekly instalments of £40. He executed a deed of assignment on December 20th, 1920, under which a dividend of 2s. in the £ was paid to the assenting creditors, whose claims amounted to about £20,000, the only dissentient being the petitioning creditor. The debtor attributed his failure to insufficiency of capital, and to his ignorance of one of the branches of the business. On the ground of insufficiency of assets to equal 10s. in the £ on the amount of the liabilities the discharge was suspended for four weeks.

P. Rothwell, in partnership with P. A. Rothwell, a minor (P. A. Rothwell & Co.), electrical engineer, 64, Higher Bridge Street, Bolton.—First instalment of composition of 6s. in the £, payable June 28th, at the Official Receiver's offices, Byrom Street, Manchester.

W. Camp (W. Camp & Co.), electrical engineer, Carr Lane, Slaithwaite, Huddersfield.—First and final dividend of 1s. 5½d. in the £, payable June 27th at the Official Receiver's office, 12, Duke Street, Bradford.

P. M. Rogers (Longbridge Engineering Co.), electrical engineer, 40, Portland Street, Aberystwyth.—Receiving order made June 14th on debtor's own petition.

G. G. Grieve and A. A. Manges (The Up-to-date Electrical and Mechanical Engineers), 14, West Bute Street, &c., Cardiff.—First meeting, June 27th, at 34, Park Place, Cardiff; public examination, July 5th, at the Law Courts, Cardiff.

E. W. Morgan, company director and electrical engineer, Eccles Mill, Monton Lane, Eccles, Lancs.—First meeting, June 28th, at the Official Receiver's offices, Byrom Street, Manchester; public examination, July 13th, at the Court House, Salford.

F. Ridgway (separate estate), carrying on business in copartnership with T. Tynan at 21, Bowling Old Lane, Bradford (Ridgway & Tynan), electrical engineer, 5, Sharp Avenue, Odsal, Bradford.—Last day for proofs for dividend July 5th. Trustee: W. Durrance, Official Receiver, 12, Duke Street, Bradford.

T. Tynan (separate estate), carrying on business in copartnership with F. Ridgway at 21, Bowling Old Lane, Bradford (Ridgway & Tynan), electrical engineer, 14, Hardy Avenue, Odsal, Bradford.—Last day for proofs for dividend July 5th. Trustee: W. Durrance, Official Receiver, 12, Duke Street, Bradford.

George Francis Coupe, 2, Spring Gardens, Stockport, Cheshire, electrical engineer.—The public examination of this debtor was held recently at the Court House, Stockport. The statement of affairs showed liabilities of £599, and there was a deficiency of £538. Debtor attributed his failure to bad trade and insufficient knowledge of the business. He stated that he commenced business as an electrical engineer in May, 1920, his father paying accounts to the extent of £100. He said that he had not sufficient experience to do the work himself, and had to rely on workmen. Debtor was closely questioned regarding some of his affairs, and was ordered to file a cash account from March, 1921, up to the date of the proceedings. The examination was adjourned.

Company Liquidations.—The Maxim Lamp Works, Ltd., 75, Canonbury Road, Highbury, N.—Under the compulsory liquidation of this company, which was formed in March, 1910, to acquire the business of the Maxim Electrical Co., Ltd., accounts have been lodged showing total liabilities, £11,050 (unsecured, £4,987); assets valued at £3,579, almost entirely absorbed by the debenture claims; and a total deficiency of £9,485 as regards contributories. Mr. E. T. A. Phillips, Official Receiver, reports that the Maxim Electrical Co., Ltd., was formed in 1904, with the object of carrying on business as manufacturers of electric lamps. On March 12th, 1908, Mr. J. F. Poynter was appointed receiver and manager by the debenture holders in respect of their debentures for £15,000. At this time the company's bankers were creditors for £1,800 for cash advanced, and had been given a first charge on the book-debts of the company, amounting to approximately £800, and other assets valued at approximately £1,000, in addition to which they held as collateral security £600 debentures forming part of the £15,000 referred to above. Mr. Poynter, as receiver and manager of the Maxim Electrical Co., Ltd., continued to carry on the business until early in 1910, with the assistance of one Taussig (who advanced £2,600) and R. W. Strange King, his accountant. Various meetings of the debenture holders were held between 1908 and 1910, and as they were satisfied that a forced sale of the company's assets would not provide a sum sufficient the discharge the bank's claim the continuance of the business was sanctioned by them. Early in 1910 arrangements were made, with the approval of the debenture holders of the Maxim Electrical Co., Ltd., to form a new company to acquire the assets of the old company. According to Mr. Poynter the purchase agreement, dated March 14th, 1910, provided

that the new company was to purchase the assets of the old company for £2,220 payable as to £720 in cash and as to £1,500 by the allotment of 1,500 fully paid preference shares of £1 each in the new company. The cash consideration was to be employed in the payment by instalments of 1s. in the £ to the debenture holders of the old company (excluding the £600 debentures held by the bank as collateral security), which would exhaust the £720. The shares forming the remainder of the consideration were allotted to Mr. Taussig in repayment of his loans to the receiver. No copy of the agreement can be found. Mr. Poynter states that another agreement was entered into at the same time between the new company and himself providing for the allotment to him of 1,500 fully-paid preference shares of the new company in consideration for his services in the promotion and for the benefit of certain contracts which he had entered into as receiver and manager of the old company. Mr. Poynter states that in his opinion the failure of the company is due to the unprofitable transactions with the Imperial Co., which had the effect of causing the company to incur great expense in the production of lamps, which were eventually left on its hands with little prospect of disposal. The Official Receiver concurs in this view, but is of the opinion that the company has been hampered by lack of sufficient working capital from its inception, and that its affairs have been mismanaged.

British Switchgear, Ltd.—Meeting of members July 26th at Australia House, Strand, W.C., to hear an account of the winding-up from the liquidator, Mr. T. D. Marshall.

Splitdorf Electrical Co. of London, Ltd.—Winding up voluntarily. Liquidator, Mr. H. J. Hinley, 162, Great Portland Street, W. Particulars of claims to the liquidator by July 5th.

Tredegars, Ltd.—Winding up voluntarily. Liquidators, Mr. N. Bell, of Messrs. T. Fuller, Carter, Son & White, and Mr. B. B. McCallum, of Messrs. Tansley, Witt & Co., 5, Chancery Lane, W.C.2. Meeting of creditors June 30th, at the Institute of Chartered Accountants, Moorgate Place, E.C. Particulars of claims by June 29th to Mr. B. B. McCallum.

Evered & Co., Ltd.—Meeting of creditors at 84, Colmore Row, Birmingham, June 23rd. Liquidator, Mr. C. H. Smith.

Keynsham Electric Light & Power Co., Ltd.—Meeting of creditors June 27th at the offices of the liquidator, Mr. A. Collins, 28, Baldwin Street, Bristol, to whom particulars of claims should be sent by July 31st.

S. Gillitt & Co., Ltd., Newcastle-on-Tyne.—Winding-up order made June 15th.

Meeting of Creditors.—Fluxio Welding Co., Ltd.—A meeting of creditors was held on June 15th, and after a very full consideration of the whole position, it was unanimously decided that the creditors should leave their debts over indefinitely to enable the company to carry on its business and as early as possible discharge the amounts. We understand that the company will probably carry on under the name of the Lackawana Steel Corporation of Britain, Ltd., and the debts will be transferred to that company.

Trade Announcements.—From June 24th the address of Messrs. Mayall & Co., Ltd., will be 6, Imperial Buildings, Dale End, Birmingham.

Mr. H. A. Machen, A.M.I.E.E., late of Messrs. Siemens Bros. & Co., Ltd., has acquired an interest in the Wainwright Manufacturing Co., Ltd., 25, Victoria Street, Westminster, S.W.1, and has become the technical director of the company. He has had between 17 and 18 years' experience in wireless work, and has been in charge of Messrs. Siemens's Wireless Telegraph Department since 1911. The Wainwright Manufacturing Co., Ltd., manufacturing electrical engineers, is extending the scope of its activities by the establishment of a wholesale factoring department. It will shortly be putting on the market newly-designed wireless sets for amateurs.

Messrs. Constable & Ohlson, electrical engineers, of 60, Queen's Road, Battersea, S.W., are removing on June 24th to 16, Surrey Lane, Battersea, S.W. Telephone: Battersea 2159.

The Commercial Cable Co. has removed its administrative and central operating offices to Mackay House, 27-33, Wormwood Street, London, E.C.2.

The Bedford Electrical & Radio Co., Ltd., electrical and wireless engineers, have taken over the business of Mr. A. J. E. Osbourn, carried on at 7, St. Peter's Street, and 22, Campbell Road, Bedford.

Mr. I. Stephenson, junr., is continuing the business of his father, the late Mr. I. Stephenson, electrical engineer, of 36 and 37, Flowergate, Whitby.

Catalogues and Lists.—Mr. E. Brontman, 139, Bournemouth Road, Parkstone, Bournemouth.—An illustrated pamphlet describing the "Electrawa" water heater.

Ateliers de Constructions Electriques de Charleroi, 56, Victoria Street, S.W.1.—A brochure (in English) dealing with the construction and manufacture of motor converters under the A.C.E.C.-La Cour patents. Illustrated.

The General Electric Co., Ltd., Magnet House, Kingsway, W.C.2.—Catalogue, Section M. An illustrated and priced list of measuring instruments, including voltmeters, ammeters, portable testing sets, insulation testing sets, &c.

Messrs. W. G. Pye & Co., Granta Works, Cambridge.—List No. 160, illustrating and describing wireless apparatus. Priced.

Carron Company, Falkirk, N.B.—An illustrated and priced leaflet describing the firm's latest design of electric cooker.

Mr. H. B. Turner, 79, Playford Road, N.4.—A price list of v.i.r. cables of various sizes, flexibles, and rubber strip.

Messrs. Fry's (London), Ltd., 46, Upper Thames Street, E.C.4.—A comprehensive illustrated and priced catalogue of hack saws, sawing machines, sawing stands, &c.

Messrs. B. Cohen & Sons, Ltd., 1-19, Curtain Road, E.C.2.—A fully-illustrated catalogue of office and library furniture of all grades, including desks, tables, filing cabinets, chairs, bookcases, &c. Also a leaflet giving prices.

Messrs. Herbert Morris, Ltd., Loughborough, Leicestershire.—An illustrated booklet, in Spanish, descriptive of the firm's various manufactures.

The Benjamin Electric, Ltd., Brantwood Works, Tariff Road, Tottenham, N.17.—Two illustrated and priced pamphlets dealing respectively with "Benjamin" electric horns and "Tip Top" push buttons.

Messrs. Watson & Sons (Electro-Medical), Ltd., Sunic House, Parker Street, Kingsway, W.C.2.—Bulletin 488, giving descriptions of a number of types of oil-immersed high-pressure transformers for X-ray work, including d.c. types fitted with rotary converters. Fully priced and illustrated.

The British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C.4.—An illustrated pamphlet of electric fans of various types—desk, ceiling, exhaust, and oscillating. Fully priced.

Messrs. Downes & Davies, 1 and 3, Stanley Street, Liverpool.—An illustrated catalogue giving full details and prices of "Apex" switch and fuse-gear.

Messrs. Richson & Co., 114, New Oxford Street, W.C.1.—An excellently-produced catalogue of all kinds of Czecho-Slovakian glassware for lighting purposes, including mosaic bowls and pendants, silhouette patterns, table standards, lanterns, &c. Also a price list of the examples illustrated.

The Davis Electrical Co., Ltd., 6, Warwick Court, High Holborn, W.C.1.—A pamphlet illustrating and describing a new type of combination plug and adaptor.

Messrs. Marryat & Place, 28, Hatton Garden, E.C.1.—An illustrated price list of electrically-driven tools, including drilling machines, grinders, polishers, &c.

Serek Radiators, Ltd., Warwick Road, Greet, Birmingham.—An illustrated booklet dealing with automobile radiators, oil coolers, &c.

Messrs. Johnson & Phillips, Ltd., Charlton, S.E.7. "Transformer Abstracts" No. 10.—This is a "Comparison of Polyphase Transformer Connections," reviewing the following connections:—3-phase to 3-phase, in eight combinations; 3 to 6-phase, in five forms; 2 to 3-phase; and 2 to 6-phase.

Messrs. W. T. Henley's Telegraph Works Co., Ltd., Blomfield Street, London Wall, E.C.2.—List UG1, illustrating and describing various types of colliery joint boxes, including straight through, three-way, and "Y" boxes. Fully priced.

Mr. J. B. Rudkin, 212a, Shaftesbury Avenue, W.C.2.—List No. 3, illustrating and describing ironclad switchgear of various types manufactured by the Sprecher & &Schuh Co., Aarau, Switzerland; and List No. 7, descriptive of apparatus for protection against current surges. Both lists are priced in Swiss francs, and metric weights and dimensions are given.

Engineering Trade Agreements.—The *Manchester Guardian* states that the secretary of the Engineering and National Employers' Federations issued the following statement on June 16th:—"The Engineering and National Employers' Federations and the National Union of Foundry Workers met in conference on June 14th, 15th, and 16th, 1922. Joint recommendations were arrived at in connection with the questions of overtime, night-shift, and systems of payment by results, and these will be submitted forthwith to the constituent bodies on both sides for ratification."

A conference which had been arranged for Wednesday at Broadway House, Westminster, between all the engineering unions and the Engineering Employers' Federation to discuss the employers' demand for a reduction of the war bonus was postponed, and efforts are being made to fix a new date.

The Boilermakers' and Iron and Steel Shipbuilders' Society has now agreed to accept the terms agreed upon between the National Employers' Federations and the trade unions.

Copper and Lead Prices.—Messrs. F. Smith & Co. report, June 20th, 1922:—Copper (electrolytic) bars, £71, 20s. increase; ditto ditto, sheets; no change; ditto ditto, wire rods, £81, 20s. increase; ditto ditto, h.c. wire, 10 7/16d., ¼d. increase.

Messrs. James & Shakespeare report, June 21st, 1922:—Copper bars (best selected), sheet and rod, no change; English pig lead, no change.

Swedish Telephone Industry.—In an interview with *Aftonbladet*, M. Johansson, Director of the L.M. Ericsson Telephone Co., stated that there had been a considerable increase in the number of inquiries for telephone plants from abroad, which indicated the beginning of an improvement in the general situation.—*Reuter's Trade Service* (Stockholm).

Our Foreign Trade.—MAY FIGURES.—The following were the values of imports and exports of electrical goods and machinery during May, 1922:—

	May, 1922.	Inc. or dec.	5 months, 1922.	Inc. or dec.
Imports:—	£	£	£	£
Electrical goods and apparatus ...	108,164	−42,857		−521,955
Machinery ...	765,830	−307,867		−2,862,223
Exports:—				
Electrical goods and apparatus ...	552,730	−1,230,849		−3,606,841
Machinery ...	3,053,053	−3,240,019		−12,183,482
Re-exports:—				
Electrical goods and apparatus ...	13,320	−1,322		−32,314
Machinery ...	86,550	−4,100		−74,426

Belgian Interests in Russia.—The chairman of the Compagnie Centrale d'Electricité, speaking at the annual meeting held in Brussels on June 12th, stated that the company had received no news from its stations at Ekaterinoslaw, Ekaterinbourg, and Berdiansk since last year.

Book Notices.—"Working of Dynamos and Electric Motors." (45 pp.). Manchester: The National Boiler and General Insurance Co., Ltd. Price 1s. 6d.—This is a useful collection of notes upon the care, working, and maintenance of rotating electrical machinery. Special attention is paid to the care of commutators, collector rings, and brushes; the starting of machines; overloading; inspection; &c. A number of photographs of damage caused by neglect or inattention are included in the booklet.

"Vacuum." By Henry A. Fleuss (27 pp.). Reading: Poynder & Son. Price 6d.—This is a short treatise on vacua by the inventor of the "Geryk" air pumps (manufactured by the Pulsometer Engineering Co., Ltd.). It contains a historical review of work on vacua mentioning Torricelli, Dewar, McLeod, and others. Several forms of air pump are described as well as numerous other devices employed in the production and measurement of vacua.

"The All-Electric Age." By A. G. Whyte. Pp. xiii+242; illustrated. London: Constable & Co., Ltd. Price 7s. 6d. net.

Engineering Directory, No. 69. April, 1922. London: Engineering, Ltd.

"The Home Radio and How to Make and Use it." By A. H. Verrill. Pp. vi+106; figs. 61. London: Harper and Bros. Price 3s. 6d. net.

Kelly's Directory of the Merchants, Manufacturers, and Shippers of the World. London: Kelly's Directories, Ltd. 64s. post free.—The 30th annual edition of this valuable work is a guide to those engaged in trade all over the world. The book, which is in two volumes, consists of some 5,000 pages, giving information as to 20,000 foreign and colonial cities and towns, under which over 1,000,000 trade descriptions are given. Volume I deals with foreign countries, and their dependencies, while Vol. II gives information concerning England, Scotland, Ireland, and Wales, the British Dominions and Possessions. Under each town heading, classified and alphabetically arranged, lists are given of all those engaged in trade, with the class of goods in which they deal. The contents are indexed in four languages, making the information easily accessible. The German section runs to 400 pages. The difficulties of obtaining reliable information as regards Russia has naturally caused this section to remain meagre. The evacuation of Egypt has caused that country to be transferred to the Foreign from the Colonial section. New frontier decisions have necessitated alterations to the maps, and in various other ways efforts have been made to bring the work up to date. A brief explanation of the arrangement of the work and a practical example of how to use it, in four languages, is given just after the title page.

Switching and Switchgear. By H. E. Poole. Pp. ix+118; figs. 23. London: Sir I. Pitman & Sons. Price 2s. 6d. net.—A very elementary book which can really only be of service to those who are almost wholly unfamiliar with the functions which switchgear is called upon to perform. To such persons the book will serve as an introduction to more advanced treatises. Chapters are included on insulating materials, breaking and making circuit, short-circuits and pressure rises, switch types and mechanisms, fuses, relays, motor starters, and instruments.

The Testing of Transformers and Alternating Current Machines. By C. F. Smith. Pp. xi+91; figs. 34. London: Sir I. Pitman & Sons. Price 2s. 6d. net.—This little volume attempts to give in compact form an outline of the main principles underlying the practice of testing alternating-current machines and transformers for commercial purposes. The book will be of service chiefly to men on the alternating-current test bed, and to a more limited extent to those engineers who are engaged in the purchase or maintenance of alternating-current machinery. The first chapter deals with the principles of a.c. circuits and testing, and the remaining chapters with specific tests on transformers, alternators, and induction motors.

Cassell's "Work" handbooks. "Electric Accumulators" (pp. 152). Edited by Bernard E. Jones, and "Wireless Telegraphy and Telephony" (pp. 152), by E. Redpath. London: Cassell & Co., Ltd. Price 1s. 6d. each net.—The first of these two handbooks treats of both the principles and construction of secondary cells. The way in which electrical energy is converted into chemical energy and *vice versâ*, is simply explained, and the methods employed in the manufacture of plates are similarly dealt with. Full instructions as to erection, commencement of charging, and subsequent treatment are given in very full detail, and notes on the best form of battery room are included. A useful chapter is that devoted to "Managing and Repairing," which contains numerous hints on "stitches in time." Chapter IX describes the types of accumulator produced by particular makers. The "wireless" book covers a great deal in a small space, and its main function is to instruct the amateur how to make up apparatus—principally for reception purposes. The simple explanations of such processes as tuning, adjustment of capacity and inductance, &c., ensure that the apparatus will not merely be made according to instructions, but will be understood.

Journal of the Institution of Electrical Engineers, April, 1922. Vol. LX. No. 308. Commemoration number.—This number contains the proceedings at the Commemoration meetings held on February 21st, 22nd, and 23rd, 1922. It gives *in extenso* the contributions to the symposium of reminiscences by eminent electrical engineers, and forms a history of the birth and growth of the electrical industry as viewed from many points. The collection is rendered all the more interesting by the personal nature of the papers, and it is improbable that such an opportunity of hearing the experiences of the founders and pioneers of electrical engineering will recur. In all there are 47 contributors, apart from Prof. J. A. Fleming's lecture on "Michael Faraday and the Foundations of Electrical Engineering," which is reprinted in full. The illustrations include portraits of those who contributed and pictures of early examples of electrical plant.

Transactions of the South African Institute of Electrical Engineers. Vol. XIII. Part 2. March-April, 1922. Johannesburg: The Institute. Price 2s. net.—This number includes a paper on "Some Effects of Explosives on Overhead Line Structures," by C. W. R. Campbell, and the authors' replies to discussions upon "Power Interference on Telephone Circuits" and "Some Problems in Machine Rock Drilling and Mine Ventilation where Electricity may be beneficially employed."

Journal of the South African Institution of Engineers. Vol. XX. No. 10. May, 1922. Johannesburg: The Institution. Price 2s. net.—Among the papers, &c., reprinted in this issue are "The Microstructure of Babbitt Metal" and discussions on the working of tungsten and refrigeration.

Manuale per il Collaudo delle Macchine Elettriche. By Ing. G. Bianchi (463 pp.). Milan: Ulrico Hoepli. Price 18.50 lire.—This summarises the methods of testing machines upon reception laid down by the Italian Electrotechnical Committee, the International Electrotechnical Commission, and the American Institute of Electrical Engineers, dealing particularly with the rules of the first committee. The first part briefly reviews the methods suggested by the above-named bodies, and contains information regarding tendering and ordering electrical machinery. Then the work goes on to deal with d.c. and a.c. motors and generators, rotary converters, transformers, accumulator batteries, cables, and insulating material. The second part deals with the measurement of resistance, potential, current, frequency, capacity, induction, work, &c.

Electric Power Systems. By W. T. Taylor. Pp. xii+107; figs. 9. London: Sir I. Pitman & Sons. Price 2s. 6d. net.—Written primarily for power station engineers and students, this little book does not describe apparatus, but deals with a large number of general matters affecting the operation of different systems. Various methods of power distribution are discussed, with a number of useful formulæ relating to power loss in alternating-current networks. Considerable space is also devoted to record keeping, both with regard to costing and the operation of the various sections of a system. Many much-discussed points arising out of modern power supply problems are dealt with, and few station engineers would fail to find something with which they were unfamiliar.

Electric Clocks and Chimes. Pp. 159; figs. 160. London: Percival Marshall & Co. Price 3s. 6d. net.—This is a practical handbook on the making of electrical timepieces and chimes, a fascinating hobby for the mechanically-minded amateur. It gives full details of a variety of movements, with numerous photographic illustrations and working drawings, based upon clocks actually made and in successful operation. The working instructions are minutely detailed, and cover ½-, ¾-, and 1-second clocks, the conversion of a grandfather clock to electric drive, the "Synchronome" system (the parts for which can be obtained from the makers), chime-operating mechanism, and dial movements driven by a master clock. Instructions are also given for the making of the case in which

the clock is housed. The book is a valuable addition to the long series of handbooks issued by the publishers of the *Model Engineer*.

"M. & C. Machine Mining." June. Glasgow: Messrs. Mavor & Coulson, Ltd. Price 6d., post free.—This issue contains articles and notes dealing with various phases of mechanical coal cutters and their employment, such as the use of the machines in troubled ground, lubrication, &c.

We have received copies of the *Brown, Boveri Review* (the house journal of Messrs. Brown, Boveri & Co., Baden) for January, February, March, and April, 1922, Nos. 1 to 4 of Vol. IX. The first of these inaugurates the English edition of the *Review*, which for the last eight years has been published in French and German; the journal is admirably produced, and contains technical articles and descriptions of the company's manufactures. It is issued monthly, price "1.20 fr. (1 shilling)," from the company's office, Trafalgar House, Waterloo Place, S.W.1. The April number includes articles on turbo-compressors and blowers and their applications; protection against abnormal pressure rises in e.h.p. installations; and Brown, Boveri mercury arc rectifiers (of which descriptions have appeared in our columns).

"Outlines of the Calculus," by T. Thomas. Pp. 127, 37 figs. London: Mills & Boon, Ltd. Price 3s. 6d. net.

"A Life of George Westinghouse," by H. G. Prout. Pp. xii+375, nine illustrations. London: Benn Bros. Price 18s. net.

Lead.—In their report dated June 17th, Messrs. James Forster & Co. state that there is little change to report in the general position of the metal. They still think that, in face of the poor state of trade, the present price of lead is too high to be maintained. The Board of Trade returns for May show: Imports, 15,860 tons; exports, 3,794 tons; leaving for home consumption, 12,066 tons.

"Delas" Air Extractors.—In a series of tests carried out in Paris upon "Delas" air extractors, made in England by Messrs. Cole, Marchent & Morley, Ltd., and described in our issues of October 21st, 1921, and April 28th, 1922, it was found that a comparison of their steam consumption with that of other first-class makes gave the following results:—

Vacuum maintained, inches.	Steam used by the C.M. & M.-"Delas" pump, per cent. less.
28.25 ...	24.9
28.50 ...	19.0
28.75 ...	22.4
29.0 ...	20.0

British Empire Exhibition.—The Secretary of State for the Colonies has made the following appointments in connection with colonial participation in the British Empire Exhibition, 1924:—Sir H. C. Belfield to be chairman of the committee to organise the East African group; Sir J. West Ridgeway to be chairman of the Eastern; and Sir Frank Swettenham of the Far Eastern groups.

Output of Russian Electrical Factories.—Reports on production that have reached the "Glavelektro" (Chief Electrical Control) show that the production of the dynamo factory, Moscow, has improved, in the months of March and April, by 8 per cent., compared with that of January and February. The largest increase is reported by the Petrograd high-pressure plant factory (formerly Siemens-Schuckert) the production of which in the months of March, notwithstanding the deficient fuel supply and the scarcity of many necessary materials, amounted to 214 per cent. of the January production. The Northern Cable factory, Petrograd, has also increased its output. Compared with January it shows an increase of 220 per cent. in March, and of 107 per cent. compared with February. The output of the Alexeievsky cable factory, of Moscow, shows a sustained level. The Factories Board notes defective work owing to the poor quality of the materials received. Capricious idleness at the factories has decreased very considerably. The production of the United Lamp Factories, of Moscow, in April, amounted to 136,496 lamps, against 177,000 lamps in the preceding month. The decline in the production is ascribed to the poor quality of the glass and wolfram, the defective capacity of the technical staff, and the generally worn-out condition of the equipment. Reference is made to the production in these factories of new welding apparatus, and successful efforts in the preparation of wolfram.

Sale of Georgetown Machinery.—A correspondent reports that high prices were obtained for electrical and engineering plant during the first half of a six days' sale carried out by direction of the Disposal and Liquidation Commission at Georgetown Factory, near Glasgow, by Mr. Matthew Marshall, auctioneer, of Glasgow. There was a large attendance of buyers, representatives being present from large industrial centres of England, Scotland, and Ireland. Bidding was keen, about £30,000 being realised during the three days. At Monday's sale 180 petrol-electric generating sets realised up to £85 each. For a miscellaneous quantity of electric cable a total sum of about £1,500 was obtained. Good prices were obtained for high-pressure and heating piping, £7,000 being received for this class of lots.

The Bordeaux Fair.—On June 15th M. Sarraut, Minister of the Colonies and M. Rio, Under Secretary of State for the Mercantile Marine, opened the sixth Bordeaux Samples Fair. The Fair includes not only the whole range of French manufactures and fancy goods, but also colonial products, both in the raw state and manufactured. The Fair was instituted during the war, and since those difficult times has much increased in prosperity; this year there are many more French and Colonial, and even foreign exhibitors than there have ever been. A number of stands have been taken by Americans and a special quarter of the Fair is devoted to Moroccan wares and products. Attached to the Fair is an international exhibition of inventions, open to all inventors anxious to gain publicity for their work; a salon of decorative arts is another feature of the fair.—*Reuter's Trade Service* (Paris).

Bennis's Contracts.—We have before us a very lengthy list of contracts for stokers, and coal-handling plants, that have been received by Messrs. E. Bennis & Co., Ltd., during the past quarter. We understand that in spite of all the difficulties experienced during the last few months, the orders placed offer a not unfavourable comparison with previous periods. The chief trouble at present is execution, owing to the difficulty in obtaining material. The stoker contracts for electrical undertakings include two chain grate stokers for the Western Electric Co., Ltd., North Woolwich; four chain grate stokers for the Stirling boilers for the Neepsend generating station of the Sheffield Electricity Department; relinking two Babcock chain grate stokers for Stretford Council Electricity Department; and six chain grate stokers for cross drum water-tube boilers, for the Spearing Boiler Co., Ltd., for Peterborough electricity works. The coal-handling plants ordered include one patent rotary truck tipper, for the Blackpool Corporation Electricity Department, and one overhead flight conveyor and one bucket elevator, for Messrs. Hubert Davies & Co., Ltd., for the Pretoria Municipality.

French Electro-metallurgical Industry.—The year 1921, says the *Revue d'Electrochimie et de Métallurgie*, was characterised by a fall in the manufacture of electrometallurgical products, lack of sales, and a decline in prices. The following were the prices current in France at the beginning and end of the past year:—Carbide of calcium (per 10 tonnes), beginning of 1921, 137 fr.; end of 1921, 83 fr. Ferro-silicon (45 per cent.), beginning of 1921, 1,200 fr. per tonne; end of 1921, 905 fr. Ferro chrome (6.8 per cent. C.), beginning of 1921, 2,600 fr. per tonne; end of 1921, 1,850 fr. Aluminium, beginning of 1921, 9.50 fr. per kg.; end of 1921, 6.50 fr.

For Sale.—Messrs. Hillier, Parker, May & Rowden will offer by auction at the London Auction Mart, E.C., on June 29th, factory premises known as Victory Works, Birds Hill, Letchworth. The premises have a floor area of about 10,600 sq. ft.

Messrs. H. W. Figg & Son are instructed by the London Armature Repair Co., Ltd., in consequence of its amalgamation with Messrs. Burdette & Co., Ltd., to sell by auction on the premises at Eastern Works, Forest Lane, Stratford, E., on June 30th, plant, machinery, &c., including motors, dynamos, &c. (See our advertisement pages to-day.)

"Arethusa" Night.—On July 14th, at the Hyde Park Hotel, "Arethusa" night will be run under the auspices of the Hyde Park Dance Club, whose entire organisation has been placed at the service of the Shaftesbury Homes and "Arethusa" Training Ship. It is desired to dispose of at least a thousand tickets to help the sterling work which is being done for poor British boys, and has been done for the past 80 years. Tickets for the ball (one guinea each, including supper, or ten for seven guineas) can be obtained from the secretaries, 164, Shaftesbury Avenue, W.C.2, or of the hon. sec. of the Hyde Park Dance Club, 222, Strand, W.C.2.

The London Fair and Market.—The organisers of this exhibition (International Trade Exhibitions, Ltd., Broad Street House, New Broad Street, E.C.2) state that they found last year that the exclusion of German and Austrian goods from the fair was a mistaken policy, and they are therefore admitting these products to the show being held at the Agricultural Hall from July 3rd to 14th.

Wet and Dry Bulb Thermometer.—Messrs. Cleworth, Wheal Co., Ltd., inform us that the number of applications for their booklet dealing with the wet and dry bulb thermometer, recently "noticed" in our columns, has been so great that the edition has been exhausted; another edition is in course of publication.

Applications for British Trade Marks.—Appended is a summary of the recent applications for British trade marks in respect of goods and productions connected with the electrical trades and industries. Firms desiring to enter an objection to any of the applications have one month in which to do so from the dates given below:—

Deucalion. No. 422,883. Class 8. Electrolytic rectifiers, components, and parts, and accumulators.—Howard W. Richards, 9, Hawarden Avenue, Wallasey, Cheshire. June 14th, 1922.

Armature Design. No. 421,388. Class 6. Electrical machinery and parts. June 7th, 1922. No. 421,390. Class 11. Accumulators, batteries, induction coils, magneto machines, apparatus for electrolysis, &c. June 14th, 1922.—The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.

Outing.—The mebers of the English Electric Commercial Department, Siemens Works Social Club, went for their annual outing on June 6th, a party numbering 130 proceeding in four charabancs to Chester. Luncheon was provided on arrival at Chester, at the Grosvenor Hotel, the chief of the department, Mr. J. Barr, presiding. After the usual toasts and votes of thanks and a few remarks by the chairman of the committee, Mr. G. L. Buckingham, the party dispersed in order to see the sights of the old city.

To Advertise Electric Cooking.—MISS ALYS M. WATERMAN, 55, Hambalt Road, Clapham, S.W.4, formerly demonstrator to some of the London supply companies, has devised an advertisement in the form of a star setting out the advantages of electric cooking. It is suitable for the purposes of electricity supply companies or manufacturers of cooking appliances, and can be obtained at the price of 35s. per thousand copies.

LIGHTING AND POWER NOTES.

Aberdeen.—PROPOSED PLANT EXTENSIONS.—The Electricity Committee has recommended the Town Council that in order to meet the increased demand for electricity, the plant at Cults sub-station be extended at a cost of £5,285, and that application be made to the Electricity Commissioners for sanction to carry out the proposed extensions.

Australia.—MELBOURNE.—YEAR'S WORKING.—The report of the city electrical engineer (Mr. W. H. Alabaster, M.I.E.E.) for the year ended December 31st, 1921, has just come to hand, together with the Electric Supply Committee's report. The total revenue for the year was £356,446, as compared with £303,589 in 1920. The total working expenditure was £234,655, as against £187,339, leaving a gross surplus of £121,971 (£116,250). After payment of capital and other charges, a net profit of £33,831 remained, comparing with £38,977 in the previous year. The total number of units sold rose from 41,954,531 to 45,264,840—an increase of 7.89 per cent. Bulk supplies to suburban authorities and to the North Melbourne Electric Tramway & Lighting Co. increased from 9,355,778 to 10,999,004. The total connections increased by 5,088 kW to 50,198 kW, and the number of consumers from 13,150 to 14,477. The plant capacity is now 21,000 kW (including a 1,200-kW battery), and the maximum demand was 20,550 kW; the load factor was 30.6 per cent. The capital expenditure during the year amounted to £168,919—a large amount necessitated by the arrears of extensions which accumulated during the war. The principal item of expenditure was £79,000 on mains. The report states that the acquisition of the North Melbourne Co.'s undertaking has been delayed by the action of the Electricity Commissioners, who so far have declined to give an opinion on the matter. The Council has affirmed its right to retain the control of the distribution of electricity in its area, having regard to the money it has spent upon the undertaking.

Ayrshire.—JOINT ELECTRICITY SCHEME.—The County Council has approved of the proposal to set up a Joint Electricity Board to control the supply of electricity in the county and burghs. It is proposed to take over the power station at Kilmarnock at present run by the Corporation. The Ayr Corporation, which is promoting a scheme of its own at Loch Doon, is offered membership of the Board, on condition that it abandons the Loch Doon scheme. A report by Messrs. Merz and McLellan, consulting engineers, states that a Joint Board would be of great advantage to the county.

Bangor.—YEAR'S WORKING.—The annual report of the electrical engineer (Mr. P. F. White) for the year ended March 31st last shows a net deficit of £668. In the previous year there was a loss of £1,480.

Blairgowrie (Perthshire).—ELECTRICITY SUPPLY.—The Town Council has under consideration a proposal to supply the district with electricity. It is intended to utilise the power derived from the River Ericht. The estimated cost of supplying electricity is 8d. per unit for lighting and 3d. per unit for power.

Burton-upon-Trent.—YEAR'S WORKING.—We have received from the borough electrical engineer and tramways manager (Mr. Thomas Hall, A.M.I.E.E.) a copy of the annual report and accounts of the electricity department for the year ended March 31st last. The total revenue from all sources amounted to £85,002, as compared with £74,683 in the previous year. The working expenses totalled £48,766, as against £47,369, leaving a gross surplus of £36,236 (£27,314). After crediting rents and deducting capital charges, cost of extensions paid for out of revenue, &c., the net result was a profit of £19,813, of which £5,000 was applied in aid of the rates and the balance transferred to renewals fund. The previous year's net profit was £12,612. The total number of units sold increased from 7,132,045 to 8,157,743, the yield per unit remaining the same. The report states that the extension of the h.p. transmission line to a number of works and collieries in South Derbyshire is well in hand, and several firms will shortly be connected. Success in the hiring of apparatus is recorded, leading to a much-increased domestic load.

Chagford.—INCREASED CHARGES.—The Electric Light Co. has notified consumers that after the June quarter the charge for electricity for lighting will be increased by 2d. per unit to 1s.

Cheltenham.—PRICE REDUCTION.—The Town Council is reducing the charge for electricity for lighting to 8½d. per unit.

Continental.—FRANCE.—Operations have been begun on the building of the great dam on the Blavet river in Brittany. The dam will be 40 metres high, with a fall of 46 metres. The hydro-electric works to be built will have a capacity of 12,000 h.p., and will supply electric energy to 450 communes and 1,000,000 inhabitants. Another scheme, to supply some 72 communes in the *départements* of Morbihan and Côtes du Nord, is the subject of a concession applied for by the Société Générale d'Enterprises. Both form parts of a large scheme intended to provide the whole of Brittany with electricity.

CZECHO-SLOVAKIA.—A noteworthy event in the Northern Bohemian electrical industry is the acquisition of the August Pannitschka electricity works by the cities of Reichenberg and Gablonz, and the authorities of the Tannwald district jointly. The purchase price is 13½ million kronen. By this transaction the generation of electricity will be cheapened and placed upon a uniform basis, while continuity of supply will be ensured. This will be achieved by the parallel working of the Reichenwald, Gablonz and Tannwald works by a 35,000-V long-distance line, while the working of the steam-power station will be dispensed with. The arrangement is a preliminary to the intended linking up of all the stations in Northern and Western Bohemia, to the benefit of the industrial and agricultural interests of these regions.

The Spindelmühle commune in the Riesengebirge has in hand a scheme, drafted by the Engineer Lederer, of Trautenau, to build a high-pressure hydro-electric station with a 220-metre fall and a capacity of 3,450 h.p. The coal saving by this step is reckoned at equal to 4,000,000 kronen annually.

The Nestomitz Sugar Refinery, which is claimed to be the biggest undertaking of its kind in Europe, intends reorganising its electrical equipment. Instead of the hitherto employed d.c. at 110 V, a.c. at 500 V will be used. To this end two 2,000-kVA turbo-generators will be installed, and a.c. motors will displace the existing d.c. motors. At the same time a transformer station will be built, and linked up to the 35,000-V line of the North Bohemia electricity works for use in case of necessity.

The City of Prague has recently contracted a loan in London of £2,580,000, bearing 7½ per cent. interest and repayable in 30 years. The sum is to be employed (1) for the extension of the town's tramway network, the purchase of 240 locomotives and trailers, erection of garages and workshops—235,000,000 kronen; (2) power and transformer stations for the railway and extensions of lines, 178,000,000 kronen; (3) the balance is to defray the cost of building a steam generating station at the Komotan Colliery, where waste coal will be utilised. The output of 45,000 kW will be transmitted to Prague, a distance of 130 km., at 100,000 V and stepped down at transformer posts at Prague and Kladno to a pressure of 22,000 kV for the distribution network. The cost of this plant is estimated at 344,000,000 kronen. The new lines will be taken in hand in the course of next year.

RUSSIA.—The fourth of June was fixed for the inauguration of the Kaschir electrical station. This station is of considerable importance, says a leading Russian economic journal. It will burn the inferior Moscow coal with special equipment. The plant, which is already unofficially running, includes two sets of 12,000 kW, which enables it to supply 30 per cent. of the electricity required in Moscow. It is, however, intended to raise its capacity to 40,000 kW, to effect which all that is wanting is the arrival of the machines already ordered from abroad.

ITALY.—The electricity supply industry in Rome is represented by the Municipal establishment and by the Società Anglo-Romana. The former, in 1921, sold 13,900,000 kW, as against 8,800,000 kWh in the previous year. The latter sold 141,844,522 kWh, against 126,205,726 kWh in 19,20 being an increase of 15,633,796 kWh or 12.39 per cent. The increases were: Private lighting, which advanced from 18,600,000 kWh to 22,700,000 kWh; and traction, which progressed from 17,600,000 kWh to 19,500,000 kWh, while the sales in the provinces rose from 34,000,000 kWh to 49,400,000 kWh. The supply of energy for heating and motive power remained practically unchanged, while the consumption of power for the manufacture of nitric acid fell from 14,300,000 kWh to 3,600,000 kWh, owing to the stoppage of manufacture in 1921. The consumers on December 31st, 1921, numbered 60,646, being an increase on 1920 of 2,992, equal to 5.4 per cent.—*L'Elettricistà*.

Dutch East Indies.—WATER POWER.—Large schemes for the utilisation of the Dutch East Indies waterfalls to provide power through the medium of hydro-electric stations are now under consideration. It is estimated that the larger falls of Java can provide from 1,000 to 5,000 h.p., and those of Sumatra between

50,000 and 200,000 h.p. According to plans, those of Java will be harnessed first to provide lighting and power for tramways and railways.—*Indian Engineering.*

Leeds.—YEAR'S WORKING.—The report and accounts of the municipal electricity undertaking (Manager: Mr. C. Nelson Hefford) for the year ended March 31st, 1922, have come to hand. A total revenue of £508,542 is shown, this comparing with £519,021 in the previous year. Working expenses amounted to £248,785, as against £313,055, leaving a gross profit of £259,757 (£205,966). The capital charges absorbed £183,162, as against £152,105 in 1920-21, giving a net result of £76,595 profit, as compared with £53,861. A sum of £49,704 was spent out of revenue for capital purposes, leaving an actual surplus of £26,891. The expenditure upon capital account amounted during the year to £452,991 (apart from the sum from revenue noted above), and additional borrowing powers to the extent of £188,500 were obtained. The reserve fund now stands at £36,579. The total number of units sold fell from 63,921,813 to 58,826,215; decreases occurring in power and traction supplies were partly compensated for by increases in other directions. The works cost per unit sold was 1.01d., as compared with 1.17d. in 1920-21. A notable decrease occurred in the fuel cost per unit sold from .65d. to .48d. The connected load increased from 91,581 kW to 99,113 kW, and the number of consumers from 22,418 to 25,616. The maximum simultaneous demand was 30,830 kW, and the plant capacity remained at 51,000 kW, owing to the non-delivery of a new 12,000-kW turbo-alternator.

Manchester.—PRICE REDUCTIONS.—The Town Council is reducing the charges for electricity for lighting: flat rate, from 7½d. to 7d. per unit; sliding scale, from 3d. to 2½d. per unit; and to ordinary power users, from 3.5d. to 3.25d. per unit.

Morocco.—WATER POWER.—A large programme of public works is to be carried out in Morocco, for which the French Government has sanctioned a loan of 740 million fr., of which 70 millions have been allotted for hydro-electric work.

Nelson.—PRICE REDUCTION.—The Town Council is reducing the charges for electricity for lighting by ½d. per unit, and for power by ½d. per unit.

Northampton.—PRICE REDUCTIONS.—The Electric Light and Power Co. has reduced the charge for electricity for power by another ½d. per unit, and for lighting by 1d. per unit, with additional reductions to large users by the introduction of the following scale:—8d. per unit for the first 200 units per quarter and 6d. beyond. The rates for hired motors have been further reduced by 10 per cent.

Northern Ireland.—WATER-POWER RESOURCES.—The suggestion has been made that, failing private enterprise, the Northern Ireland Government should take in hand as a national asset the development of water-power for electrical purposes in the River Bann area. The practicability of such a scheme has been already discussed in the report of the Water-power Resources Committee dealing with Irish areas, and there is a keen desire in other industrial areas along the Bann that an early development should be undertaken. A proposal has now been made, at the instance of Mr. C. S. Meik, that the weir at Toome should be removed and that a set of sluices should be substituted, which would give a fall of 17 ft., which is estimated to produce 3,381 electrical h.p., to which might be added a further 1,988 h.p. at Movanagher under a fall of 10 ft. The estimated cost of the works is £360,800, or £64.4 per h.p.; the estimated cost per unit for continuous power is ½d. In this calculation account is not taken of the storage capacity of Lough Neagh, which, if utilised, would make nearly 12,000 estimated h.p. available, though probably at a higher cost. A similar scheme is outlined for the River Foyle area.

Oxford.—PROPOSED CHANGE OF SYSTEM.—The Corporation has approved the application of the Oxford Electric Co., Ltd., for consent to alter the present system of supply from d.c. at 100 V to a.c. at the same voltage, on the understanding that the company carries out the alterations at its own expense.

Philippines.—IMPROVEMENTS AT MANILA.—An official report states that plans are under consideration for various improvements in the city of Manila, which may later be of interest to contractors and exporters of machinery and iron and steel products. Among them is the plan for using the Angat River as a source of water supply for the city. If the proposed plans are approved, a hydro-electric plant will be constructed, the sewer system will be extended, and the present Montalban reservoir will be used for irrigation. It is thought that the total cost will be from $8,000,000 to $9,000,000, and considerable amounts of cast-iron pipe, steel of various kinds, cement, lumber, electrical apparatus, copper, and aluminium will be used, as well as machinery of various kinds.—*Indian Engineering.*

Portsmouth.—PRICE REDUCTIONS.—The Town Council has reduced the price of electricity for lighting to 7d. per unit for the first 5,000 units per annum; 6½d. from 5,000 to 7,500; 6d. from 7,500 to 10,000; 5½d. from 10,000 to 20,000; and 4½d. beyond.

Rotherham.—LOAN.—The Finance Committee has recommended that application be made to the Electricity Commissioners for sanction to the borrowing of £12,000 for electricity purposes.

Rushden.—PRICE REDUCTIONS.—The Electric Supply Co., Ltd., has reduced the charge for electricity for power by ½d. per unit, and for lighting to 10d. per unit for the first 200 units per quarter, and 8d. beyond.

St. Helens.—LOAN SANCTIONED.—The Council has received the sanction of the Electricity Commissioners to the borrowing of £33,774 for mains and services.

Saltcoats (Ayrshire).—STREET LIGHTING.—The Town Council has remitted to the Roads Committee the question of the electric lighting of the principal streets within the burgh.

Sunbury.—ELECTRICITY SUPPLY.—The District Council has instructed the clerk to write to Mr. Clifford Pressland, of Hampton, as to the terms upon which he would be willing to supply the district with electricity.

Tunbridge Wells.—YEAR'S WORKING.—The accounts of the electricity undertaking (Engineer: Mr. R. N. Torpy, M.I.E.E.) for the year ended March 31st last show a total revenue of £40,645 and a working expenditure of £24,446, leaving a gross profit of £16,199. Capital charges, &c., absorbed £8,734, leaving a net profit of £7,465—the highest in the history of the undertaking. The prices of energy during the year were 8d. per unit for lighting and 3d. for power; these are being reduced to 7d. and 1½d. per unit respectively. The total number of units sold increased from 1,260,670 to 1,452,429, and the connections (30-W lamp equivalent) from 189,659 to 208,410.

United States.—LARGE HYDRO-ELECTRIC SCHEME.—An application has been filed with the Federal Power Commission by the American Super-Power Corporation which proposes to build a hydro-electric power transmission line from Lewiston, Niagara County, to Yonkers, N.Y., where connection would be made with local lines supplying New York City. The estimated cost of this line is $27,457,000, the power corporation promising to supply energy not only to the companies distributing power in New York City, but also to communities in the south, central, and south-eastern parts of New York State where power is not at present available. The plans were revealed when the Super-Power Corporation asked the Federal Power Commission for preliminary permits to develop the additional water diversion to be authorised in an amended treaty with Great Britain. The suggested amendment would allow 80,000 instead of 56,000 cu. ft. of water per second to be diverted. The proposed transmission line to New York City will consist of four circuits, each capable of carrying 75,000 kW, at 220,000 V, three-phase current, at 60 cycles. These circuits will be carried on two independent power lines on a right of way 350 ft. wide. It is declared in the papers filed that the applicant can supply the base load for corporations distributing electric energy in New York at a great saving in the cost of power, as well as meet the increased power demands in New York and the intermediate towns and villages.—*Reuter's Trade Service* (Washington).

Whitehaven.—LOAN SANCTIONED.—The Town Council has received the sanction of the Electricity Commissioners to borrow £3,500 for services and £2,800 for the extension of the mains to the Council houses at Bransty. The Council has decided to oppose the application by the Cumberland Waste Heat Owners' Co., Ltd., for a Special Order to empower the company to supply electricity in the urban districts of Egremont and Cleator Moor.

TRAMWAY AND RAILWAY NOTES.

Bradford.—YEAR'S WORKING.—The annual report on the working of the tramway undertaking for the past year shows a net profit of £20,000.

Glasgow.—PURCHASE OF SUBWAY.—The Glasgow Subway Co. has agreed to accept the offer of the Corporation to purchase the undertaking for £385,000. It is proposed to electrify the line, and steps are being taken to ascertain whether the tunnel is architecturally suited for speedier and heavier traffic. The estimated cost of electrifying the line is £125,000.

Continental.—ITALY.—It is announced that two new lines are about to built by the State department in Sicily, namely, the Polizzi-Collesano-Campofelice and the Catania-Giarre-Kiposto, in the Etna forest region. The concession for the building of the Siena-Buenconvento-Monteantico line, granted to the Société Française de Chemins de Fer en Toscane, has been taken over by the Società Italiana per Imprese Ferroviarie e Lavori Pubblici, which assumes all the former company's rights and obligations. The date of completion of the line is postponed until December of the present year.

TELEGRAPH AND TELEPHONE NOTES.

Finland.—TELEPHONE EXTENSIONS.—The President of the Finnish Republic has approved the Finnish Telegraph Department's proposal to arrange telephone communication between Petsamo, Finland, and Kerkenaes, Norway.—*Reuter.*

India.—TELEPHONE DEVELOPMENTS.—A new flotation by the Bengal Telephone Corporation, Calcutta (capital Rs.2,00,00,000), to carry on and extend existing business is reported.—*Reuter's Trade Service.*

Ireland.—CABLE STATION RAID.—During Sunday night armed men forcibly entered the Valentia Island cable station of the Anglo-American Telegraph Co., off the south-west coast of Ireland, and smashed several instruments, the estimated damage being £3,000.

Morocco.—EXTENSIONS.—A huge programme of public works is to be carried out in Morocco, for which the French Government has sanctioned a loan of 740,000,000 fr., of which about 130,000,000 fr. are allotted for roads, posts, telegraphs, and telephones.

Russia.—TELEGRAPHIC CONVENTION.—The provisional Telegraphic Convention between Finland and Russia was signed at Helsingfors on June 14th. By the Convention, which was to come into force ten days after the signature, telegraphic connection between Finland and Russia will be resumed over the Helsingfors-Moscow and Viborg-Petrograd lines. The Finnish Government will not oppose telegraphic communication being established between Northern Norway and Northern Russia over Finnish territory.—*Reuter.*

PRESS TELEGRAM SERVICE.—A service of Press telegrams at 2½d. a word, *i.e.*, half the ordinary rate, is now available between this country and Russia, both by the Government-owned Anglo-Russian cable and by the Great Northern Telegraph Co.'s route, says *The Times.*

South Africa.—WIRELESS BROADCASTING.—On June 12th the *Cape Argus* began a temporary wireless telephone service. The experiment was highly successful, and the programme, which contained songs, was clearly heard by many local amateurs, by ships at sea, and also by the Port Nolloth wireless station, 280 miles distant.—*Reuter.*

The Telephone Service.—SCOTTISH DEVELOPMENTS.—The further development of the telephone service in the Highlands was foreshadowed when General Price, Secretary of the Post Office for Scotland, formally opened at Auchnacarry what is really the first completed public circuit in the rural part of the west—that between Auchnacarry and Fort William.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Australia.—PERTH (W.A.).—July 26th. Postmaster-General's Department. Telegraph and/or telephone apparatus, testing instruments, protective apparatus (sched. 734.) (June 9th.)

WARATAH (N.S.W.).—July 31st. Commonwealth Steel Products Co., Ltd. One 300-kW rotary converter, complete with transformer, switchgear, instruments, &c. The manager.

MELBOURNE.—July 11th. Postmaster-General's Department. Telegraph and telephone instruments and parts, silk and cotton insulated switchboard cable, rubber insulated tinned copper wire. (Sched. 25.)

August 15th. Tinned copper wire. (Sched. 31.)

July 4th. C.B., automatic C.B., and magneto telephones, wall and table patterns. (Sched. 34.)

August 22nd. Silk and cotton-covered switchboard cable. (Sched. 35.)

July 25th. Paper insulated cable and lead-covered submarine telegraph and telephone cable. (Sched. 42.)

October 17th. Automatic C.B. telephone equipment, with all associated equipment, including apparatus for use at subscribers' premises. (Scheds. 39 and 40.)

August 9th. Protective apparatus. (Sched. 563.) (See this issue.)

Azores.—PONTA DELGADA.—July 3rd. Municipal Council. Hydro-electric plant, comprising steel pipe line, two 430-h.p. Francis turbines or two Pelton wheels, two 300-kVA alternators with exciters, control gear, switchboards, &c., two 300-kVA step-up transformers, one 10-kVA transformer, plant for ten transforming sub-stations, comprising one 125-kVA, four 50-kVA, and 50 30-kVA transformers h.p. cable, material for h.p. line and l.p. distribution, telephone line, material for public lighting.*

Belgium.—July 13th. Seven communes in the Province of Limburg are inviting tenders for the establishment of a system of high-pressure electrical distribution. The communes in question are respectively Lommel, Overpelt, Neerpelt, Hamont, Lille-Saint-Humbert, Achel, and Caulille. Specifications from 99, Rue des Flamands, Louvain (7½ fr. each).

The municipal authorities of Glons (Province of Liége) have this week invited tenders for the concession for the supply of electricity for lighting and power purposes in the town.

Bulgaria.—SOFIA.—June 30th. Director-General of Bulgarian Railways. Electric travelling platform for locomotive repair shops.*

Cheadle and Gatley.—July 10th. Urban District Council. A.c. meters and maximum demand indicators. (See this issue.)

Connah's Quay.—July 14th. U.D.C. Sub-station equipment, overhead and underground mains, public lighting and consumers' services. (See this issue.)

Dundee.—Town Council. Electrical fittings for Council Chamber, &c., Caird Hall. Mr. Jas. Thomson, city architect.

Egypt.—CAIRO.—August 22nd. Egyptian State Railways. Supply of desk and wall telephones. Copies of the specification may be obtained on application at the Stores Department, Saptia (Cairo), or Gabbary (Alexandria). Manager, Egyptian State Railways, Cairo Station. Simultaneous offers will be received at the office of the Administration's Inspecting Engineer in London, Major J. S. Liddell, C.M.G., D.S.O.—*Reuter's Trade Service* (Cairo).

Gellygaer.—July 4th. Urban District Council. Transformer plant, e.h.p. and l.p. switchgear, steel poles, h.d. copper wire, cable and boxes, &c., for the Ystrad Hengoed scheme. (See this issue.)

Glasgow.—June 30th. Corporation. Electric lighting installation of Belvidere Hospital. Specifications, &c., from Electrical Engineer, 75, Waterloo Street.

Gravesend.—July 17th. Electricity Department. One 5,000-kW turbo-generator, condensing plant, switchgear, mains, artesian well, automatic stokers. (See this issue.)

Ilford.—July 10th. Electricity Department. Mechanical stokers for two marine dryback boilers. (June 16th.)

India.—July 14th. Bombay, Baroda, and Central India Railway Co. Metallic-filament lamps. (See this issue.)

July 14th. High Commissioner's Department. Submarine cable, v.i.r. insulated and lead-sheathed cable, and braided wire. (See this issue.)

Kirkcaldy.—July 10th. Electricity Works. Converting plant, specification No. 2. (June 16th.)

London.—L.C.C. July 15th. Wiring of the buildings, motors, telephones, and supply and fixing of overhead electrical conductors and main cables, switchboards, &c., at the Eleventh Mental Hospital, Epsom. (June 9th.)

MILE END.—Board of Guardians. Two 300-A switchboards, motors, &c., for the Bancroft Road institution. (June 16th.)

H.M. OFFICE OF WORKS.—July 4th. Electrical and/or mechanical engineering labour-in-daywork in Manchester. (June 16th.)

June 30th. Supply of incandescent lamps. (See this issue.)

Manchester.—June 28th. Electricity Committee. Subsidiary cables between generators, auxiliaries, transformers, and switchboards in the Barton power station, &c. (June 2nd.)

June 30th. Electricity Department. Supply, &c., at the Middleton sub-station, of two 3,000-kVA, 3-phase "Outdoor" weatherproof-type transformers; or, alternatively, two 3,000-kVA, 3-phase "Indoor" type transformers.

Navan.—July 12th. Electricity Department. D.c. main switchboard, d.c. generators, overhead mains, including erection, d.c. oil engine set, house service meters and fuses, public lighting fittings and brackets, lamps, insulated aerial and lead-covered cables, insulating material, insulators, leading-in tubes, wall spikes, &c. (See this issue.)

New Zealand.—July 10th. Southland Electric Power Board. Transformers, bare copper cable and jointing sleeves, lightning arresters and choke coils, pole type switches, pole type fuses, insulators. (See this issue.)

Nottingham.—July 3rd. Board of Guardians. Installation of an electric clock at the Bagthorpe Institution and infirmary. (June 16th.)

Portsmouth.—June 28th. Board of Guardians. Three months' supply of electrical fittings. Mr. H. C. Morrell, Guardians' Offices, St. Michael's Road, Portsmouth.

Preston.—June 28th. Electricity Department. E.h.p. switchgear. (June 2nd.)

Reigate.—June 27th. Town Council. Diesel engines and single-phase alternators, &c. (June 9th.)

Salford.—July 3rd. Electricity Department. E.h.p. and l.p. switchgear and transformers for the Agecroft power station. (June 16th.)

South Africa.—ROBERTSON.—August 14th. Town Council. Two 75-kW steam sets and accessories; one 300-Ah battery; material for distribution, &c.*

July 14th. Rand Water Board. Electric cables, junction boxes, &c.*

Southend-on-Sea.—Electricity Department. One 480/550-V, d.c. generator, with 500/550-V shunt regulator, to be direct coupled to a prime mover; also one 480/550-V, d.c. generator, 600/650 kW, to be direct coupled to a prime mover, both generators to be of the multi-polar type. (June 9th.)

St. Helens.—July 19th. About 800 tons of tramway rails and fish plates, for Town Council. Borough engineer.

*A copy of the plan, specifications, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

Torquay.—July 12th. Electricity Department. One 3,000-kW turbo-alternator and condensing plant. (See this issue.)

Tynemouth.—June 26th. Electricity Department. A.c. booster. (June 2nd.)

Wimbledon.—July 10th. Electricity undertaking. Four 1,000-kVA 10,000/2,000-V transformers. (See this issue.)

CLOSED.

Aylesbury.—Town Council. Accepted:—
Turbo-alternator (£10,302).—British Thomson-Houston Co., Ltd.

Ayr.—Tramways Department. Accepted:—
Electric cable to Alloway (£4,792).—Callender's Cable & Construction Co., Ltd.

Barnes.—Electricity Department. Accepted:—
1,750 yd. distributor cable (£530).—Pirelli-General Cable Co., Ltd.

Belgium.—Six concerns—four Belgian, one Dutch, and one German—submitted tenders on June 9th to the municipal authorities of Schaerbeek, Brussels, for the supply of a quantity of h. and l.p. armoured cables required in connection with the electricity supply undertaking. The lowest offer was that of the Nederlandsche Kabelfabriek, of Delft, Holland.

Blackpool.—Electricity Committee. Accepted:—
Construction of an electrical transformer chamber in Abingdon Street, Blackpool.—Dryland & Preston, Ltd.
Switchgear cubicles.—General Electric Co., Ltd.
Erection of a cooling tower.—P. Brotherhood & Co.

China.—Tenders for the supply of plant, machinery, rolling stock, &c., in conection with the Peking tramways have been accepted as follows:—
Boilers (109,000 gold dollars).—Messrs. Babcock & Wilcox.
Engines and generators (109,000 gold dollars).—Brown, Boveri Co.
Transformers (24,000 gold dollars).—Siemens Co, (German).
Rails (295,000 gold dollars).—French company, through the Anglo-French Corporation.
Cars (£55,000).—Same tenderers.
Overhead equipment.—Siemens Co.—*Reuter's Trade Service* (Peking).)

Doncaster.—Town Council. Accepted:—
Two water-tube boilers, with economisers, induced draught plant, and steel chimney (£21,663).—Babcock & Wilcox, Ltd.

Electricity Committee. Accepted:—
Service cables for Carr House, Arksey, and for general purposes (£686).—Callender's Cable and Construction Co., Ltd.
E.h.p. switchgear for Arksey sub-station (£96).—Johnson & Phillips, Ltd.

Douglas (Isle of Man).—Town Council. Accepted:—
Underground mains and accessories (£8,237).—Siemens Bros. & Co., Ltd.

France.—The Paris-Orléans Railway has recently placed an order for 80 electric locomotives with the Société Oerlikon and the Société de Construction des Batignolles, both in Paris. These locomotives are each for a 1-hour rating of 1,720 h.p. The Société Oerlikon is to supply and erect the electrical equipment, while the Société de Construction des Batignolles deals with the mechanical part. Except in the case of the first five locomotives, which will be completed in Switzerland at the works of the Ateliers de Construction Oerlikon (who are represented in this country by Messrs. Oerlikon, Ltd., London), and will serve as models, the whole electrical equipment will be built in France, to the Oerlikon design, at the works of the Société Oerlikon. We understand that the locomotives are specially intended for goods trains and are to be capable of hauling a load up to 1,200 tons; they are, however, also to be suitable for passenger service, in which case a speed of about 68 miles per hour must be attainable. The locomotives will be equipped with four motors wound for 1,500 volts, d.c., and having each an output of 430 h.p. measured at the wheel rim.

Lancashire.—Linden Hall.
Electrical equipment, including generating plant, accumulators, motors, pumps, lighting, bells, and telephones.—Mr. Harry Moss, Bradford.

London.—L.C.C.—Highways Committee. Accepted:—
Twelve months' supply of traction-type electric lamps (standard vacuum and gasfilled) for tramcar lighting; also automobile lamps.—English Electric and Siemens Supplies, Ltd.

Manchester.—Electricity Committee. Accepted:—
One 15-ton overhead travelling crane at Greenwood Street sub-station.—Vaughan Crane Co., Ltd.
One 56-ton transformer truck and portable platform for Barton power station.—E. Wood & Co., Ltd.

Tramways Committee. Accepted:—
Two electrically-driven portable concrete mixers.—Millar's Timber and Trading Co., Ltd.
Electrically-driven air compressor.—Ingersoll Rand Co.
Tramcar trucks.—Brush Electrical Engineering Co., Ltd.

Housing Special Committee. Electric lighting installation. Accepted:—
18 houses on Newton Heath estate.—J. V. Pyatt.
32 houses on Gorton Mount estate.—E. M. Evans & Son.
24 houses on Catterick Hall estate.—J. V. Pyatt.
222 houses on Fallowfield estate.—Alliance Electric Co.

Margate.—Town Council. Accepted:—
Electric signs on three lavatories (£86).—E. C. Spray.

Sunderland.—Corporation. Accepted:—
Tramway rails.—Steel, Peech & Tozer.
D.c. meters.—Ferranti, Ltd.
L.p. cable.—Pirelli-General Cable Works, Ltd.
Electric blower.—Consolidated Pneumatic Tool Co., Ltd.
Two ½-ton soot wagons.—W. G. Allen & Sons, Ltd.
A.c. and d.c. disconnecting boxes.—Callender's Cable & Construction Co., Ltd.
Feeder pillar.—Henley's Telegraph Works Co., Ltd.
Steam pipe covering.—Sutcliffe Bros. & Bryce, Ltd.

York.—In connection with its development scheme, the York Waterworks Co. has accepted the tender of Messrs. Ruston & Hornsby, Ltd., of Lincoln, for three double-cylinder Ruston cold starting oil engines of 160 b.h.p. to be coupled direct to three high-lift pumps, each capable of an output of over 90,000 gallons per hour against a head of 200 ft. Additional plant consists of a double-cylinder Ruston oil engine of 100 b.h.p. to be coupled to a low-lift pump with an output up to 300,000 gallons per hour against a head of 40 ft. For lighting purposes a Ruston single-cylinder oil engine of 15 b.h.p., direct coupled to an 8-kW dynamo, will be supplied.

FORTHCOMING EVENTS.

Societe des Ingenieurs-civils de France (British Section).—Monday, June 26th. At the Institution of Mechanical Engineers, Storey's Gate, S.W. At 5.30 p.m. Paper on "The Rhine Lateral Canal," by M. A. Antoine.

Institution of Civil Engineers.—Tuesday, June 27th. At the Institution, Great George Street, S.W. At 8.30 p.m. Annual conversazione.

Institution of Electrical Engineers.—Wednesday, June 28th. At the Institution, Victoria Embankment, W.C. At 4.30 p.m. Unveiling and dedication of the war memorial.

Thursday, June 29th. At the Natural History Museum, South Kensington, S.W. From 8.30 to 11 p.m. Annual conversazione.

Electricity District Inquiry.—Second inquiry by the Electricity Commissioners in connection with the South-West Midlands area. Thursday, June 29th. At the Council House, Birmingham. At 10.30 a.m.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

To enable us to complete replies to queries received this week we need the names of suppliers or manufacturers of:—

The Vreeland oscillator for the production of currents of varying frequency (used in laboratory work).

NOTES.

G.P.O. Engineers.—The Civil Service Correspondent of the *Daily Telegraph* states that the Civil Service Commission has declared the result of the open competitive examination, held in April and May last, of candidates for situations as assistant engineer in the Engineer-in-Chief's Department of the General Post Office. The following, in order of merit, are the successful candidates:—

C. A. Beer, W. G. Radley, H. G. Davis, A. C. Warren, G. J. S. Little, L. H. Harris, F. I. Ray, J. H. Reyner, W. T. Palmer, W. E. Hudson, H. R. Harbottle, N. Yeadon, W. E. Beer, W. West, and F. R. Perris.

The subjects of examination were: Mathematics, electrotechnology, materials, theory of machines, personal qualities (a subject never seen hitherto at a Civil Service examination), and one only of the last three, *viz.*, alternating currents, electrical machines, heat engines. Sixty-eight candidates in all entered for the examination.

Efficiency of Wireless Watchers.—The Merchant Shipping Advisory Committee, which was requested in December, 1921, to inquire into the efficiency of watchers and the sufficiency of Section 1 (2) of the Merchant Shipping Wireless Telegraphy Act, 1919, had the advantage of hearing the views of representatives of the Association of Wireless Telegraphists, of witnesses nominated by the Shipowners' Parliamentary Committee, the Institute of Marine Engineers, and the Imperial Merchant Service Guild, and of Commander F. G. Loring, R.N., Inspector of Wireless Telegraphy of the General Post Office. The time at the disposal of the Committee before the expiry of its term of office was, however, not sufficient to enable it thoroughly to investigate the cases submitted by the Board of Trade. As, however, after examination of these cases it appeared that in only four of them was technical inefficiency on the part of the watchers alleged, the Committee considers that, even if the allegations made should on further inquiry be sustained, they do not afford ground for advising any alteration in the present regulations. At the same time, the evidence in general reveals that in some cases there exists a want of friendly co-operation between the operators and the watchers, and the Committee is firmly of the opinion that shipowners, masters, and seamen's organisations should be impressed with the desirability of encouraging such co-operation in the interests of all on board. It further most emphatically holds the view that watchers should not be removed from their duty during their period of watch.

Wireless Telegraphy and Signalling Act, 1922.—A Bill has been presented to Parliament by the Postmaster-General, to amend the Wireless Telegraphy Act, 1904, and to make further provision with respect to the regulation of wireless telegraphy and visual and sound signalling. The Bill, which has been read a second time, porposes that the Wireless Telegraphy Act, 1904, shall become a permanent Act.

The Postmaster-General may make regulations as to the terms subject to which licences, under the principal Act, are to be granted or withdrawn; for preventing interference with the working of wireless telegraphy by the generation or use of etheric waves for any purpose other than the transmission or reception of wireless messages; and for giving effect to, and securing compliance with, the provisions of any international convention.

Any person acting in contravention of the regulations shall be liable, on summary conviction, to imprisonment for a terms not exceeding three months, or to a fine not exceeding fifty pounds.

Sub-section (6) of section one of the principal Act is hereby repealed.

Sub-section (1) of section two of the principal Act, which makes special provisions as to licences for experimental purposes, shall cease to have effect.

A person shall not send by wireless telegraphy a message of an indecent or offensive character; or a signal of distress of a false or misleading character, or improperly divulge the purport of any message sent by wireless telegraphy.

Any provisions of the principal Act or this Act which are applicable to ships, shall apply also to aircraft, with the necessary modifications.

(1) The provisions of the principal Act as amended by this Act shall apply to any visual or sound signalling station used or intended to be used for the purpose of communication from the British Islands with ships at sea as they apply to wireless telegraphy stations.

It shall be lawful for the Postmaster-General during an emergency to make such rules as appear necessary with respect to the possession, sale, purchase, construction, and use of apparatus for wireless telegraphy, or visual or sound signalling, or component parts of such apparatus, and to impose penalties and forfeitures in respect of any breach of the rules.

Magneto Research.—In report E.S.C. 52 of the Aeronautical Research Committee it was shown that the sparking performance of an induction-type magneto, with shunt resistance, could be improved from 45 to 60 per cent. by reducing the secondary turns from the standard number of 10,000 to 7,000. A later report by Dr. G. E. Bairsto, No. 724 (E.1), I.C.E. 313, extends the observations to a rotating armature magneto. Measurements are given for a Bosch D.U.4 machine of the spark voltage for various leaks and armatures having from 900/8,400 secondary turns. Low-speed characteristics, the shunt capacity characteristics, and the effect on the working of the primary circuit of reducing the secondary turns are considered. The conclusions arrived at are that the optimum number of secondary turns is 7,200 (standard number is 8,400) and the average increased performance is 11 per cent. The shape of the low-speed characteristic curve is practically unaltered. This is also shown to be in agreement with the theoretical analysis. The shunt secondary capacity characteristic curve shows an increased performance of 12 per cent. and the primary capacity needed to avoid arc-flashing is slightly increased, but this does not affect the performance with shunt resistance. It is shown theoretically that the primary maximum potential is proportional to k^2N_1/N_2^2. It is intended to extend the measurements to a battery and coil system, and at the same time a series of measurements of the various constants of the various windings will be carried out.

Electric Signs.—Mr. G. P. Garbett, who was responsible for the construction of the electric signs described in our issue of April 7th, read a paper on this subject before the National Association of Supervising Electricians on May 9th. This paper was a study of the factors which go to make or mar the effectiveness of electric signs, and covered both theoretical considerations and details of practice. Most elements of successful design are based on due regard to the fact that objects separated by less than a minute of arc to the eye are not separately distinguishable. If, therefore, at the maximum distance at which it is desired that the sign should be readable, the spacing between adjacent strokes in a letter, or between the adjoining letters, is such as to exceed the minimum angle, the definition will be clear to the average eye. If it is desired to secure continuity or a line of light it is clear that the lamp spacing must be less than the minimum angle. The proportions of each letter must be such that the letter appears clear to the observer both by day and night, and although the two are not always best served by the same proportions, it has been found in practice that letters having a length equal to two-thirds of the height will give the best results, both as regards readability and appearance, under both conditions. As regards the width of the letters, while by day the greater the width the better the result, at night the readability increases as the width decreases owing to the non-uniform distribution of the light over a wide surface. The form of mounting found to meet all requirements in the best possible manner is the channel form, which by day relieves the bare look of the sign and affords much better protection to the lamps than other forms. At night it acts as a concentrating reflector and prevents the light from "spilling" over and lighting up the background. The most suitable lamp is the 10-W size with a screw top; the best socket is a porcelain shell containing the holder. For letters 3 ft. or more in height the most satisfactory spacing is 6 in.

Appointments Vacant.—Mains assistant, for the Fulham B.C. electricity works; resident engineer (£300), for the Gorseinon Electric Light Co., Ltd.; station superintendent, for the Loughborough Corporation electricity department; charge engineer, for the Ashton-under-Lyne Corporation electricity works. (See our advertisement pages to-day.)

"Electric Heating by Accumulation."—A pamphlet with the above title has been published by the British Electrical Development Association (E.D.A. No. 270), in which the views of M. Charles Boileau upon a "policy of electric heating" are put forward. M. Boileau say that, hitherto, supply undertakings have met increased production costs merely by raising their tariffs, although the real remedy lies in an alteration of the character of their load. To offer cheap night rates is of little assistance to the domestic consumer, who requires to use his cookers, radiators, &c., during the day. The solution of the problem is the provision of appliances which will accumulate energy while it is cheap and release it when required by the consumer. "There will not be a wide development of the use of electricity for heating until we break deliberately with the existing policy in distributing electrical energy. By installing accumulating methods we can give to the people the hygienic advantages and conveniences of electric heating on a large scale, at the same time contributing to our own prosperity by permitting the use of thousands of kilowatts of plant now idle during the greater part of the twenty-four hours, economising in fuel, and bringing down the cost of producing electricity for all our consumers together."

Obviously it is difficult to fit special requirements to special supplies of surplus energy, but this difficulty could be, to some extent, reduced by interconnection on an extensive scale between different supply areas. Apart from water heating, dry heat accumulation stoves are made by several Continental firms. These have elements buried in inert matter capable of accumulating heat, such as steatite, concrete, or carborundum, the whole of which is enclosed in a heat-insulated casing, and generally with heat-insulating air spaces. The heat is released by opening vents, which allow air currents to pass through the stove. In most cases these stoves require eight hours charging and discharge over a period of sixteen hours. In one small Continental city there are at present 1,400 heat accumulation stoves and 1,200 boilers working on the same principle, representing a night load of 5,000 kW. There is a number of successful water heating appliances upon the English market, but a study of the dry-heat method, which is not so well known, might prove profitable.

Electricity Districts. — SOUTH-EAST LANCASHIRE. — The second local inquiry relative to the constitution of the South-East Lancashire Electricity District and the establishment of an Advisory Board for that area, was opened at the Manchester Town Hall, on Tuesday morning. The Commissioners have issued a draft order which was submitted to the constituent authorities of the district. The inquiry occupied a little more than two hours. It was largely of a formal character. The representatives of the London & North-Western & Midland Railway Companies objected to clauses which would have made it obligatory to supply statistics to the Board, and to accept the decision of the Commissioners with regard to recommendations by the Board upon alterations or extensions of the plant. The Town Clerk of Manchester, on behalf of the Conference of authorised undertakers who promoted the scheme, proposed that a clause be added to the order instructing the constituent authorities to advise the Board of any new contracts made by them. The Commissioners were Sir Harry Haward and Mr. H. Booth. In closing the proceedings, Sir Harry Haward said this was the first occasion upon which a second inquiry had been completed, and it was probable that the order for South-East Lancashire would be the first to go through Parliament.

LONDON & HOME COUNTIES.—The Electricity Commissioners in their decision (ELEC. REV., December 23rd, 1921; p. 866), on the scheme submitted at the London inquiry in June and July, 1921, stated that they concurred generally in the technical proposals for the first stage of development, but that they differed from the promoters on the proposals for the second stage. The Commissioners said that their alternative proposals for the later stage should bring about "an annual saving of upwards of £1,000,000 (15 per cent. and 10 per cent. in fuel, with all the advantages derivable from a capital station, such as availability for large railway or other supplies in bulk on favourable rates."

Subsequent correspondence took place between the Commissioners and the Engineering Committee appointed by

the London County Council, and the Conference of Local Authorities, and nine electricity supply companies, with the result that the Commissioners have agreed that a substantial modification must be made in the figures for comparative purposes with a consequent substantial reduction in the estimated saving between the Commissioners' proposals and those of the promoters. The Commissioners are of opinion that in fairness to the Engineering Committee this should be made known to the promoters.

The Commissioners, nevertheless, adhere to their conclusion that their alternative proposal to supplement existing stations during the second stage by capital stations (if the rate of growth estimated by the promoters is realised) will result in substantial economy compared with a further comprehensive extension of existing stations. The impression which appears to have arisen that the Commissioners desire to fetter the engineers of the future Joint Authority by proposals made now for dealing with the demands during the second stage of development, is unwarranted.

The consent given by the Commissioners to the County of London Electric Supply Co. to construct a station at Barking with an installation of 100,000 kW is (in the language of the agreement between that company and the London Joint Committee (1920), Ltd., read to the Commissioners at the inquiry on July 28th last) "for the needs of the County Co.'s own statutory obligations only." Whether or not that station will, hereafter, be made a capital station for wider purposes is a matter for the consideration of the future Joint Authority in the first instance, and for subsequent approval by the Commissioners.

INSTITUTION NOTES.

Institution of Electrical Engineers.—SUMMER MEETING OF THE WESTERN CENTRE.—A Summer Meeting of the Western Centre of the Institution is to be held in the Gloucester district on July 24th, and the following programme has been drawn up: Assemble at Gloucester on the Monday; leave by charabancs for Cheltenham, where a Committee meeting will be held at 11.45 a.m. Luncheon will be served at 1 p.m. at the "Pump Room," Cheltenham, after which a charabanc drive will commence at 2.15 p.m., travelling *via* Leckhampton Hill, Birdlip, Cranham, Painswick, Stroud, visiting the works of the Erinoid Co., or J. Walker (Sticks), Ltd., Woodchester, and Stroud. The party will then proceed *via* Stonehouse and Eastington to Framilode where tea will be served, and thence back to Gloucester, where an evening visit to the Cathedral is to be arranged. The cost to each person for luncheon, tea, and the charabanc drive will be from 12s. 6d. to 15s., and it is hoped that as many as possible will take part in the meeting. The complete success of the meeting cannot be attained without the support of the ladies, and early application for tickets is requested. To ensure absolute sociability, members are asked not to use any private motor cars after assembling at Gloucester.

Sheffield and District Wireless Society.—On and after June 23rd, the address of the Hon. Secretary of the Society will be 18, Linden Avenue, Woodseats, Sheffield.

Hull Association of Engineers.—On June 13th, Mr. N. W. Prangnell gave a lecture and demonstration before a large meeting of the Association on the subject of the "Laval Centrifugal Method of Purifying Lubricating and Electrical Oils, and the Separation of Liquids of Varying Specific Gravity." The lecture was illustrated by a number of slides which covered the theory of separation by centrifugal force, as applied to these machines, and pictures were shown of a number of installations. A small capacity machine was used for a practical demonstration, and it was successfully shown how simple it was to return to its virgin condition some oil which was contaminated by the addition of 50 per cent. of water, and a quantity of sand and graphite.

Röntgen Society.—The following officers have been elected for the session of 1922-1923:—*President*, Sir Humphrey Rolleston, K.C.B.; *Vice-Presidents*, Prof. Sir W. H. Bragg, K.B.E., F.R.S.; Prof. Sir Ernest Rutherford, F.R.S.; A. E. Barclay, M.A., M.D. *Hon. Treasurer*, Geoffrey Pearce. *Hon. Secretaries*, E. A. Owen, M.A., D.Sc.; Russell J. Reynolds, M.B., B.S. *Hon. Editor*, G. W. C. Kaye, O.B.E., M.A., D.Sc.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Battersea Borough Council Staff Committee reports that the Electricity Committee has informed it that as the plant capacity of the Council's electricity undertaking has been increased from 10,000 kW to 12,350 kW, the Council's electricity staff, at present in class E, are entitled to come into class F in accordance with the schedule of the National Joint Board of Employers and Members of Staff of Electricity Undertakings and to receive the salaries payable under the new grading. The Committee recommends that the new grading and salaries be adopted. The following will be the salaries from June 1st, 1922:—

Mr. H. F. J. Thompson, chief assistant, from £745 to £778; Mr. T. Bennett, station superintendent, from £560 to £584 (less £50 in respect of residence, fuel, light, &c.); Messrs. E. S. Colley, C. E. F. Evans, H. Brotchie, shift engineers, from £359 to £385; Mr. W. Magrath, mains assistant, and Mr. W. Mears, meter superintendent, from £359 to £385; Mr. A. S. Knight, installation inspector, from £345 to £378; Mr. A. W. Batten, commercial assistant, from £345 to £378; Mr. G. Carr, commercial assistant, from £306 to £332; Mr. F. Favell, draughtsman, from £322 to £354.

The salaries are adjusted according to the rise or fall in the cost of living, and at present are based on the cost of living being 95 per cent. above pre-war level.

Messrs. KENNEDY & DONKIN are removing their offices from Victoria Street, S.W., to Broadway Court, 8, Broadway, Westminster, London, S.W.1. Their new telephone number will be Victoria 3601 (three lines).

Mr. JAMES E. SAYERS, M.I.E.E., has taken as a partner MR. THOMAS G. CRUM, B.Sc., A.M.I.E.E., who has been his assistant for several years. The business will be carried on under the name of James E. Sayers & Co., consulting engineers and electricians, at 190, West George Street, Glasgow.

Mr. A. J. BRIDGE has left the Metropolitan-Vickers Electrical Co., Ltd., Manchester, and has been appointed head of the Publicity Department of the Brush Electrical Engineering Co., Ltd., Loughborough.

The Rt. Hon. W. C. BRIDGEMAN, M.P., Secretary for Mines, announces that in connection with the forthcoming retirement of Mr. J. Dyer Lewis, H.M. Divisional Inspector of Mines in charge of the South Wales Division, he has promoted Mr. J. M. CAREY, at present serving as a Senior Inspector in that division, to be Divisional Inspector in place of Mr. Dyer Lewis, and Colonel J. A. S. RITSON to be a Senior Inspector of Mines in place of Mr. J. M. Carey.

Southport Town Council has appointed MR. W. T. GANN as principal assistant to the electrical engineer at a commencing salary and bonus of £470, increasing by two annual increments to £580.

Captain CLEMENT JACKSON, M.C., motor-'bus superintendent in the Sheffield city tramways department, who has been trained and had experience in all departments of the Sheffield tramway service, was, on June 14th, selected as tramways general manager to the Keighley Corporation. There were 92 applicants. Capt. Jackson succeeds Mr. J. A. Bromley, who was recently appointed general manager of the York tramways.

The marriage took place on June 3rd of MR. D. S. DEARDEN, assistant electrical engineer at the Hebden Bridge electricity works, and MISS ETHEL PICKLES, youngest daughter of Councillor S. Pickles, Hebden Bridge.

Wimbledon Town Council has made a grant of £75 to Mr. W. J. OSWALD, chief assistant electrical engineer, for the services rendered by him as acting chief electrical engineer from February 1st to May 31st, and has decided that he be informed that the Committee appreciates the admirable manner in which he had performed the duties devolving upon him, and the courtesy shown by him during that period.

A Sydney newspaper reports that on April 20th a dinner to welcome home MR. F. GOLDING, chief electrical engineer, Postmaster-General's Department, was given by the staff of the engineering branch of the Sydney Post Office. Mr. J. M. Crawford, State engineer for New South Wales, presided. Mr. Golding had just returned from a tour abroad, extending over 12 months, examining the latest developments of telegraph and telephone work. In responding to a toast, Mr. Golding stated that with the improvements which would shortly be introduced in the Commonwealth, there should be no difficulty in speaking from Perth to Brisbane, when these cities were connected by trunk telephone lines. He had been greatly interested in the staff welfare schemes which were everywhere being introduced into the telephone exchanges, and great manufacturing concerns of America and England, and which were far in advance of anything hitherto attempted in Australia.

It is stated that Mr. PERCY CAMPLING, deputy engineer of the Rhondda Tramways Co., has been appointed to take charge of the Yarmouth Corporation tramway undertaking.

Barnes Urban District Council Electricity Committee has considered the salary of the electrical engineer, Mr. DAVIDSON, and reports that under an award he is entitled to a much higher salary than that being received at present, viz., £952, also that he has not been paid the full Civil Service award on his existing salary, but on the salary granted previous to 1914. The Committee recommends that the time has arrived when Mr. Davidson's salary should be fixed without reference to a war bonus, and that as from June 1st, 1922, his salary should be £1,000 per annum, and that it should include bonus.

Mr. ARTHUR L. MADDEN has been appointed manager by Mr. Harry Rogers, electrical engineer and contractor, Warrington, in place of Mr. J. B. Robertson, who has left his service.

The marriage took place on 13th inst., at Nelson, between Mr. ALAN E. DENT, A.M.I.E.E., contracting electrical engineer, of Nelson, and Miss Ethel Ball, of Stoke-on-Trent.

Mr. ROBERT LEACH, A.M.I.E.E., has been appointed sales engineer to Messrs. Ferguson, Pailin, Ltd., for Lancashire, Yorkshire and North Wales areas.

Obituary.—MR. G. G. WARD.—We regret to learn of the death, which occurred in New York on June 15th, of Mr. George Gray Ward, chairman, vice-president and general manager of the Commercial Cable Co. and the Commercial Pacific Cable Co. He was also a director of the Direct West India Cable Co., Ltd., and the Halifax and Bermudas Cable Co., Ltd. George Gray Ward was born at Great Hadham, Hertfordshire, in December, 1844. He developed a taste for telegraphy at an early age, and while still at school received a prize for knowledge of the art. Upon graduation he entered the employment of the Electric Co., and, attracting attention because of his aptness and industry, he rose rapidly. In 1865 he entered the Egyptian Government telegraph service, and for some three years was stationed at Alexandria. He was one of the few Europeans to stick to his post during the cholera epidemic of 1865, and his valuable services were specially recognised by the Viceroy, Ismael Pasha. Resigning from the Egyptian service in 1869, he joined the first French Atlantic Cable Co., and was assigned to accompany the *Great Eastern* as a member of the electrical staff during the laying of that company's cable. Later, as superintendent of the Direct United States Cable Co., he organised that company's system in the United States. Here he made his first great impression upon the industry, to the furtherance of which he was to devote his entire life. Through his efforts the transmission of messages between New York and London was so

Elliott & Fry] [*London.*

THE LATE MR. GEO. GRAY WARD, CHAIRMAN OF THE COMMERCIAL CABLE CO.

greatly accelerated that arbitrage transactions between the Stock Exchanges of the two cities were accomplished, a feat which had not been possible before. He also accelerated the transmission of news dispatches between the old world and the new, and it was he who introduced the system of registered addresses, which has since been adopted throughout the world, and has saved the cabling public millions of dollars. In 1884 Mr. Ward became general manager of the Commercial Cable Co., and in 1890 he was elected vice-president, both of which positions he held until his death. Mr. Ward, in this new field, was even more successful than he had been in earlier positions; his sound judgment and business ability, together with his power to maintain discipline while holding the respect and affection of his subordinates, were assets of the utmost value. In 1906, after the laying of the Commercial Pacific Cable, he was decorated by the Emperor of Japan with the Order of Commander of the Rising Sun. He was a member of the Institution of Electrical Engineers, and acted on the other side of the Atlantic as local honorary secretary and treasurer of that Institution.

MR. FRANCIS R. REEVES.—With further reference to the death of Mr. F. R. Reeves, F.C.I.S., of which we made brief mention last week, we understand that the deceased gentleman was manager of the Jablochkoff Electric Light & Power Co. In 1877 he was called in by the then firm of R. E. Crompton and Co. and assisted in the conversion of that business into a limited liability company, with the title of Crompton & Co., Ltd., remaining with it for some years as secretary and subsequently as general manager, from which position he retired in 1905. His son, Mr. E. Reeves is managing director of the company to-day. It is of interest to recall that Mr. Reeves was one of the first members of the Dynamicables and of the Electro-Harmonic Society.

NEW COMPANIES REGISTERED.

Summit Electrical Co., Ltd. (182,383).—Private company. Registered June 9th. Capital, £100 in £1 shares. To carry on the business of electrical engineers, manufacturers of, dealers in, and agents for all kinds of general electrical supplies, motor cars and parts, and all materials, apparatus, and requisites for kinematograph theatres, &c. The subscribers (each with one share) are: A. Bonnella, "Woodstock," Swain's Lane, Highgate, N.6, manufacturing electrician; G. J. Bonnella, "Kenilworth," Bow Lane, North Finchley, N.12, manufacturing electrician. The subscribers are to appoint the first directors. Registered office, 11, Bucknall Street, Bloomsbury, W.C.2.

W. H. Sugden & Co., Ltd. (182,446).—Private company. Registered June 13th. Capital, £2,500 in £1 shares. To adopt an agreement with W. H. Sugden and to carry on the business of electrical, mechanical, and general engineers, manufacturers and workers of and dealers in electricity, &c. The first directors are: W. H. Sugden (permanent managing director), 50, Jersey Road, Ilford; Mrs. D. E. Sugden, 50, Jersey Road, Ilford. Qualification: £100. Secretary: H. C. Mundy. Registered office: Glenny Road, Barking.

E. N. Bray, Ltd. (182,489).—Private company. Registered June 15th. Capital, £3,000 in £1 shares. To carry on the business of electrical engineers, contractors and manufacturers, &c. The first directors are: E. N. Bray, 7, Bisterne Avenue, Walthamstow, E.17; E. S. Dawn, 19, Hermitage Road, Westcliff-on-Sea, Essex; R. C. Court, 17b, Sandcroft Street, Kennington Cross, S.E.11. Qualification: £100. Secretary: E. S. Dawn. Solicitors: Warrens, 5, Bedford Square, W.C.1.

Johnson Savage & Co., Ltd. (182,492).—Private company. Registered June 15th. Capital, £500 in £1 shares. To carry on the business of electricians, mechanical engineers, suppliers of electricity, &c. The provisional directors are: R. M. Johnson, 189, Wightman Road, Harringay, N., merchant; E. M. Savage, Nithsdale, Eversley Park Road, Winchmore Hill, N.21, merchant. Secretary: E. M. Savage. Registered office: 1, Argyle Street, Oxford Circus, W.1.

Dundee Electrical Repairs Co., Ltd. (12,256).—Private company. Registered in Edinburgh June 12th. Capital, £3,000 in £1 shares. To carry on the business of repairing all classes of electrical plant and machinery, &c. The first directors are: W. Brand, 191, Clepington Road, Dundee, engineer; W. A. Andrew, 191, Clepington Road, Dundee, engineer; T. Innes, 187, Clepington Road, Dundee, engineer; J. P. Andrew, 23, Halbeath Road, Dunfermline, vintner; J. Taylor, Forth Street, Dunfermline, confectioner. Qualification: £100 shares. Secretary: Wm. A. Andrew. Registered office: Graham Street, Dundee.

British Radiophone, Ltd. (182,427).—Private company. Registered June 13th. Capital, £2,500 in £1 shares. To carry on business as manufacturers of and dealers in apparatus of all kinds relating to wireless telephony and telegraphy; to deal with land and submarine telegraphs, &c. The first directors are: N. de M. Watsham, Beechdale, Western Elms Avenue, Reading; A. H. S MacCallum, Hillcroft, St. Peter's Hill, Caversham. Registered office: 33, King Street, Covent Garden, W.C.

Verdon Cutts & Co., Ltd. (182,419).—Private company. Registered June 12th. Capital, £10,000 in £1 shares. To acquire the business of a consulting and contracting engineer and electro-metallurgist carried on by V. O. Cutts at Townhall Chambers, 87, Fargate, Sheffield, as "Verdon Cutts and Co.," and to carry on the business of electrical and mechanical engineers, founders, ameltets, smiths, &c. The first directors are: C. Longbottom (chairman), Forest Hill, Worksop; V. O. Cutts (permanent managing director), Tregenna, Sunnyside, Worksop; D. Flather, Banner Cross Hall, Sheffield; D. E. Beardshaw, 3, Crescent Road, Sheffield. Qualification: £250. Remuneration (except permanent managing director) as fixed by the company. Secretary: A. E. Cutts. Registered office: Town Hall Chambers, 87, Fargate, Sheffield.

Specialities (Liverpool), Ltd. (182,418).—Private company.—Registered June 12th. Capital, £2,000 in £1 shares. To take over the whole or any part of the property, assets, goodwill and all or any of the debts, liabilities and engagements of H. F. Kerley and Winifred E. Kerley, trading at 45, Seel Street, Liverpool, as "The Electrical Specialities Co.," and to carry on the business of manufacturers, importers and exporters of and dealers in electric lamps, shades and electrical accessories of all kinds, &c. The permanent directors are: H. F Kerley (managing director), 45, Seel Street, Liverpool; Winifred E. Kerley, 45, Seel Street, Liverpool. Qualification: 200 shares. Remuneration (except managing director) as fixed by the company. Solicitor: W. Abercromby, 14, Cook Street, Liverpool.

Evered & Co., Ltd.—Registered on June 12th as a private company, with a nominal capital of £50,000 in £1 shares. The objects are: To acquire all or part of the undertaking and assets of the business carried on by Evered & Co., Ltd., in London, Birmingham and elsewhere, and to carry on the business of brassfounders, coppersmiths, wrought and cast iron workers, ironmongers, hardware merchants and factors, stampers, piercers, electroplaters, gilders, engravers, manufacturers of tubes, and gas, water, steam, electric light and power fittings and apparatus, stoves, lamps, burners, monumental brasses, ecclesiastical and other metal work, cabinet and furniture makers, timber merchants, box, crate and packing case manufacturers, manufacturers of paint and varnish, metal and wood bedsteads, ship berths, mattresses and bedding, &c. The signatories to the memorandum of association (each subscribing for one share) are: S. Evered, 25, Highfield Road, Edgbaston, manufacturer; J. H. Wilson, Derridge House, Derridge, Warwickshire, manufacturer The first directors are:: J. H. Wilson, H. E. Wilson, E. A. Wilson and S. Evered. Qualification: £1. Remuneration (except managing and specially remunerated directors) not more than £2,000 per annum divided between them. Solicitors: Pinsent & Co., 6, Bennetts Hill, Birmingham. No notice of situation of registered office was filed at time of incorporation. The file number is 182,412.

Electrico, Ltd. (182,506).—Private company. Registered June 16th. Capital, £6,000 in £1 shares. To carry on the business of manufacturers of, and dealers in, electrical goods, &c. The permanent directors are: E. Brontman, 139, Bournemouth Road, Parkstone, Dorset (managing director); A. E. Glassey, "The Homestead," 22, Penn Hill Avenue, Parkstone, Dorset; F. R. Ozzard, "Charlton," Woodside Road, Parkstone, Dorset; H. Kirby, Linden Hall Hydro, Old Christchurch Road, Bournemouth; J. Brewer, "Hatfield," Poole Road, Branksome, Bournemouth West. Qualification: 150 shares. Remuneration: £5 each per annum. Secretary: H. G. Perrett. Registered office: 105, Old Christchurch Road, Bournemouth.

Bedford Electrical and Radio Co., Ltd. (182,405).—Private company. Registered June 12th. Capital, £1,000 in £1 shares. To acquire the business of electrical engineers, builders, carpenters and joiners, house decorators, and automobile engineers carried on by A. J. E. Osbourn, and to carry on the business of electricians, manufacturers and repairers of or dealers in mechanical and electrical appliances, including telegraphs, telephones, wireless telegraph and telephone apparatus, &c. The first directors are: A. J. E. Osbourn, 6, Larke Street, Bedford; C. T. Morris, Quaker's Farm, North Crawley, Bucks. Qualification: £1. Registered office: 22, Campbell Road, Bedford.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

J. E. Lester & Folwell, Ltd.—Mortgage dated May 20th, 1922, to secure £3,000, charged on 60, London Road, Leicester. Holder: F. W. C. Bowler, Kirby Muxloe, Leicestershire.

Calcutta Tramways Co., Ltd.—Satisfaction in full on June 2nd, 1922, of second debenture dated December 13th, 1921, securing £150,000.

Chagford & Devon Electric Light Co., Ltd.—Satisfaction to the extent of £2,925 (being amount issued) on May 8th, 1922, of debentures, dated January 16th, 1911, securing £3,000.

Edmundsons Electricity Corporation, Ltd.—Satisfaction in full on June 2nd, 1922, of charge dated April 13th, 1920, securing £100,000 prior lien stock.

Olso-Light Co., Ltd.—Particulars of £15,000 debentures authorised May 21st, 1922; charged on the company's undertaking and property, present and future, including uncalled capital; present issue £2,500.

Burke Electrical Manufacturing Co., Ltd.—Debenture dated June 9th, 1922, to secure all moneys due or to become due, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: J. Bibby, 36, Kingsway, W.C.

Coates & Co. (Sheffield), Ltd.—Particulars of £6,500 debentures authorised June 9th, 1922, charged on the company's undertaking and property, present and future, including uncalled capital (if any); whole amount issued.

Hindhead and District Electric Light Co., Ltd.—Issue on June 6th, 1922, of £100 debentures part of a series already registered.

Newcastle and Sunderland Oxy-Electric Welding and Metallurgical Co., Ltd.—Debenture to bearer dated May 17th, 1922, to secure £300, charged on the company's undertaking and property, present and future, including uncalled capital; present issue £2,500.

Midland Electric Light and Power Co., Ltd.—Particulars of £20,000 debentures, authorised December 22nd, 1921; charged on the company's undertaking and property, present and future, including uncalled capital; present issue £14,000.

Issue on December 12th, 1921, of £10,000 debentures, part of a series already registered.

W. A. Meadows & Co., Ltd.—T. W. Hayes, of 13, Albion Street, Hanley, ceased to act as receiver on December 5th, 1921. (Notice filed June 9th, 1922.)

Hackbridge Electric Construction Co., Ltd.—Mortgage dated May 25th, 1922, to secure £10,000 charged on land, buildings, machinery, &c., at Hackbridge, Surrey. Holder: A. I. Drapkin, 33, Highbury Place, Highbury, N.

Saunders Electrical Co., Ltd.—Debenture dated May 23rd, 1922, to secure £1,000, charged on the company's undertaking and property, present and future, including uncalled capital, subject as to certain leasehold premises to a prior mortgage. Holders: G. E. Stanley, 23a, Coundon Road, Coventry, and C. G. Tysoe, Godiva Street, Coventry.

Arrota Electrical and Motor Accessories Co., Ltd.—Particulars of £15,000 debentures authorised October 28th, 1921; whole amount issued; charged on certain land and premises in South Lincs., subject to mortgage for £3,000 and the company's undertaking and property, present and future, including uncalled capital.

Newmarket Electric Light Co., Ltd. (44,450).—Capital £30,000 in £10 shares. Return dated April 3rd, 1922. 2,656 shares taken up. £26,560 paid. Mortgages and charges, £14,200.

City of London Electric Lighting Co., Ltd. (34,406).—Return dated March 29th, 1922. Capital, £2,000,000 in £1 (400,000 6 per cent. first preference, 300,000 8 per cent. second preference, 800,000 ordinary, and 500,000 undenominated). All the preference and ordinary shares taken up. £1,500,000 paid. Mortgages and charges, £800,000.

Rustproof Engineering Co., Ltd.—Particulars of £1,000 debentures, authorised June 8th, 1922, charged on the company's undertaking and property, present and future, including uncalled capital; whole amount issued.

CITY NOTES.

Richardsons, Westgarth and Co., Ltd.

The profit for 1921 was £305,208, plus £54,027 brought forward, but less two years' preference dividend to April, 1919, paid in June last (£42,000). After paying debenture interest, preference dividend for the year ended April, 1920, putting £45,000 to depreciation, £50,000 to reserve, and providing £50,000 for development of Diesel engines for ship propulsion (which are to be manufactured under licence from Messrs. Beardmore), it is proposed to pay two years' preference dividend (to April, 1922), to pay 8 per cent. on the ordinary shares, and to carry forward £54,785. It is stated that the financial position of the company is at present stronger and better than ever before.

South Wales Electrical Power Distribution Co.

The directors, in their report for the year ended December last, state that the units sold amounted to 46,533,098, a decrease of 10,510,549, as compared with 1920. This decrease is attributed largely to the stoppage in the coal industry and to difficulties with the plant which have now been remedied. The commercial side of the undertaking is operated by the Treforest Electrical Consumers Co., Ltd., and after payment of all working expenses there is a credit balance from that company of £35,294, which, with £4,417 brought forward, makes available a balance of £39,711. Deducting the interest on the two classes of debenture stock of the company and depreciation on the new plant, £3,653 remains to be carried forward. The agreement between the company and the Treforest Electrical Consumers Co., Ltd., has been revised, and the company's Bill adjusting the ordinary share capital and containing other provisions advantageous to the shareholders has been passed by the House of Lords and read a second time in the House of Commons. The Electricity (Supply) Bill introduced into Parliament by the Government is receiving the careful attention of the directors. Mr. W. Gascoyne Dalziel, chairman of the company since 1907, has resigned the chairmanship, to which Mr. Westgarth Forster Brown has been elected. Mr. Dalziel still remains a member of the board.

Edmundson's Electricity Corporation, Ltd.

The directors in their report for the year ended March 31st, 1922, state that after providing for income tax, mortgage and note interest and debenture stock charges, the net profit amounts to £31,369, as compared with £16,053 for the previous year. With the balance of £14,143 brought forward, the total profit available is £45,512. The directors recommend payment of the dividend for the year, and the arrears of dividend, on the cumulative preference shares, absorbing £24,000; and a dividend of 3 per cent. on the non-cumulative preference shares, £6,000; leaving to be carried forward £15,512. During the year, £56,100 of the 6½ per cent. three-year notes were paid off at a premium of £230 10s., leaving £18,900 outstanding. The directors intend to redeem these remaining notes when they fall due for repayment next February. In the meantime, they have arranged with the trustees to accept Government bonds in lieu of prior lien debenture stock as collateral security for the notes, and the prior lien debenture stock has accordingly been released and cancelled.

CAPITAL EXPENDITURE AND GROSS PROFITS OF SUBSIDIARY AND OTHER COMPANIES.

Name.	Capital expended Dec. 31st, 1921.	Gross profit (before providing for capital charges and depreciation). 1921.	Load connected in kW. 1921
Alderley	£59,284	£5,268	0
Bromley	169,861	18,359	26
Folkestone	2e0,555	18,858	7,002
Guernsey	168,942	16,527	6,142
Isle of Wight	290,033	20,525	7,075
Ilfracombe	36,084	2,407	1,198
Lancashire Co. ..	1,561,331	94,332	40,806
Lymington	39,409	3,568	969
Melton Mowbray ..	49,789	7,166	1,409
Newmarket	46,051	3,435	1,888
North of Scotland ..	140,184	11,459	5,297
Ramsgate	55,545	8,033	2,067
Scarboro' Trams ..	99,430	307	—
Salisbury	77,509	9,103	87
Southwold	4,503	509	250
Urban Co. Group ..	1,656,902	105,164	48,120
Whitchurch	6,724	1,0 2	159
Wycombe	127,938	17,004	3,661
Cromer	34,520	451	768
Dorking	47,265	3,028	1,610
Frome	68,342	5,292	2,472
Hamilton	98,084	5,039	3,945
Surbiton	77,125	5,976	2,988
Total 1921	£5,174,859	£363,617	146,794 kW.
,, 1920	£4,792,655	£299,774	134,259 kW.

Lisbon Electric Tramways, Ltd.

The result of the company's operations for the year ended December, 1921, after deducting interest and amortisation due on the debentures of the Companhia Carris de Ferro de Lisboa, and after the payment of £24,415 interest on and redemption of the debentures of this company, and also the payment of London expenses and directors' remuneration, shows a loss of £29,184. To this is added the balance of loss brought forward from last year, £19,271, which gives the sum of £48,455 to be carried forward to the debit of next year's profit and loss account. During the past year the tramways have carried 83,626,312 passengers with receipts of Esc. 11,102,068, as compared with 80,567,940 passengers and receipts of Esc. 6,088,286 in the preceding year. The working of the tramway was again adversely affected by the stoppage and restriction of the service owing to strikes and other disturbances, but notwithstanding these disadvantages it will be seen that a larger number of passengers was carried; the receipts also showed a substantial increase, the period covered having the full benefit of the higher fares put into force in June and December of the previous year. The rate of exchange at the beginning of the year stood at 6½d. per Escudo and at the close of the year had fallen to the low figure of 4 7/16d. This has materially increased the working expenditure and especially the cost of all supplies purchased outside of Portugal. No increase in the fares was obtained during the period under review, although constant applications were made both to the Government and the Camara, in view of the operating losses. A Commission was appointed in July last by the Portuguese Government to

inquire into the matter, but its recommendations were not carried out as the Camara withheld its approval, and it was not until the present year that an agreement was at last concluded, to enable an increase in the tariffs to be made, which it is hoped will put the company's future operations on a sounder basis.

Electric Construction Co., Ltd.

Mr. P. E. Beachcroft presided over the annual meeting, held on June 15th, and in moving the adoption of the report congratulated the shareholders on the fact that the accounts showed a reduction in net profit of only £425, as compared with the previous year. The gross profit from manufacturing and contracting was £19,530 less, but that was made up, all but £425, as follows: Interest, dividends, and transfer fees produced £8,243 more; general charges and directors' fees were reduced by £3,370; and maintenance of plant and building by £7,492. The net revenue for the past financial year amounted to £82,685, which is being dealt with as stated in the report. The transfer to a dividend equalisation fund was a new departure. Keeping in view, however, the uncertainty regarding next year's trading, in consequence of the severe depression in trade which still prevailed, he felt confident they would endorse the directors' recommendation. The abolition of Excess Profits Duty enabled them to make this provision for the coming year, and he was only sorry that while congratulating themselves on the abolition of a short-sighted and injurious form of taxation, he was unable to couple with it the withdrawal of the Corporation Profits Tax, which was equally condemned.

There were one or two items in the balance sheet on which he had to comment. The first was properties, patents, and goodwill, which now stood at £350,705. Since the accounts were made up, a careful valuation made by their own staff on a very conservative basis had been completed, from which it was evident that the value of buildings, plant and machinery and other fixed assets exceeded the amount in the balance sheet. The result of this valuation was what was expected, as the properties for many years had been maintained out of revenue in a high state of efficiency, and the provision for depreciation had also been liberal. They considered, therefore, that the reference to patents and goodwill in the balance sheet should in future be eliminated. That would improve the appearance of things. Stock-in-trade and work in progress and sundry debtors were considerably less than last year, and reflected the depression in trade through which they were passing. The directors, however, did not take a despondent view of the prospects, but so long as the trade of the country continued to be paralysed by one strike after another, trade was bound to suffer. Work in progress on March 31st last was considerably reduced, but he was pleased to say that the conditions had improved and orders since the beginning of the new financial year were 50 per cent. greater than in the corresponding period last year. Whether the improvement would be maintained he was not prepared to prophesy, but the settlement of the engineer's lock-out should give the trade of the country a considerable impetus. The next item was investments, amounting to £292,167, the valuation having been made at the market prices on March 31st or under. They had a very substantial appreciation on investments bought and sold during the financial year, but no part of the appreciation had been brought into the accounts. When trade revived they would have to realise a large portion of those investments, and if prices should be less than those prevailing on March 31st, they would have a substantial internal reserve to fall back upon. On the other side of the balance sheet it would be noted that £47,200 of their debenture stock had been cancelled. For some years they had been purchasing what stock came on the market, and keeping it alive for the purpose of re-issue if necessary. This was merely a precaution adopted when they first began to redeem the stock, but as there was now little likelihood of their requiring to re-issue, the amount purchased to March 31st last had been cancelled, and any purchases in the future would also be cancelled. Sundry creditors and credit balances amounted to £79,231, but no less than £52,200 was provided for Government taxation. With the abolition of excess profits duty there would be a larger reversion of profits to the shareholders, but it should be kept in view that income tax would be greater in consequence, although they would, of course, benefit by the reduction from 6s. to 5s. in the £. It was unnecessary to emphasise the financial position of the company, as the accounts spoke for themselves, but he considered that their position reflected great credit upon those who administered the business. They were not caught with a large stock at inflated prices, and any depreciation had been fully provided for. Provision had also been made against forward contracts for their staple articles of consumption, and the new financial year would accordingly not be handicapped in those respects. He was pleased to be able to report that notwithstanding all the unrest in the industrial world, the relations with their own workpeople continued to be of the most harmonious character, and operations in their workshops had proceeded without interruption. They had, of course, suffered indirectly through the prolonged dispute in the engineering industry, and it was to be hoped that a greater amount of co-operation would prevail in future. To the staff and workpeople generally their best thanks were due for their efforts during the past year. So far he had dealt with the affairs of the company, but he might be permitted to add a few words on the general situation. The engineering dispute had delayed a long looked for revival in trade, but they were glad to note that a settlement had been reached after prolonged negotiations. It had been the lot of the chairmen of most industrial companies to present very unfavourable balance sheets and profit and loss accounts to their shareholders during the past year, and many large and important companies had had to divert profits from the pockets of the shareholders to make good heavy depreciation in stocks, and in many instances gross profits had been converted into deficits, which would have to be made good in future years. The aftermath of the disastrous war had left a legacy which, to make good, would require all the best and latent energies of those who carried on the trade of the world. It was common knowledge that when peace was declared it was anticipated that an era of prosperity would set in for many years, and manufacturers purchased huge stocks at prices which beat all records, anticipating that the wastage caused by the war would create a demand for many years to come to make good the devastated areas. The result they all knew. There was a boom in trade for a short time, but owing to the lack of purchasing power of every country, except America, this boom "petered out" all too soon, and many of those who had stocked their barns to overflowing had to write down the stocks they were carrying to current values. He repeated what he said last year that before the country could recapture its export business lower costs of production were essential, and those could only be obtained by a lower standard of wages and salaries, by a lower margin of profit, and by increased output. But above all, there must be co-operation between capital and labour, for without it all efforts would be in vain. To that end he would counsel the adoption to a far greater degree than hitherto of the piecework system, which was not now regarded by labour with the same antagonism as formerly. If adopted labour would procure week by week the fruit of its own effort without being dependent on profits which were not ascertained for many months, but it also involved absolute good faith on the part of employers regarding the strict observance of contracts made as the results of experience and after proper deliberation. Mr. James Gray (managing director) seconded the motion, which was adopted without discussion.

British Electric Traction Co., Ltd.

Mr. J. S. Austen, the chairman, presided over the 26th annual meeting held at the Holborn Restaurant on Friday last, and in moving the adoption of the report, said that the board asked the shareholders to sanction the payment of a dividend of 4½ per cent., as compared with 4 per cent. a year ago. Some of them might ask why the directors paid an increased dividend when their earnings were only about the same as they were a year ago. The answer was that they believed their income was more stabilised and that it was daily becoming more stabilised still, and consequently they felt justified in going much nearer to their limit than they had done before. Put briefly, during the past year they had earned the 4½ per cent. dividend which they proposed to pay, and in addition they had earned a sum of about £31,500. Out of that sum they proposed to put £14,000 odd to reserve, and to add about £17,000 to the carry forward. The net results were almost exactly the same as they were a year ago, but there had been very considerable changes in the component parts, which had produced those results. They had had increases on some of their investments aggregating about £41,500, but against that they had had losses on others amounting to £40,000. It was only to be expected in a company like that with a multitude of investments that the gains, as a rule, would meet the losses and in good years would surpass them. It was difficult to draw any general conclusions from the results of the past year, but it would probably interest them if he summarised what the various branches of the business were doing at the present moment. Their main business might be divided into three classes:—tramways, electric power, and electric lighting. With regard to tramways during the current year up-to-date, there had been a failing off in the receipts. It might not be quite safe even to try and specify what that falling off was, but it amounted to about 20 per cent. That was a serious amount, but against that the tramways would make a very considerable saving in expenses. On the whole he rather doubted whether the results from the working of the tramways this year would be so good as they were in that under review. As to electric power, it was obvious that owing to the engineering strike and depression in trade, there would be a decrease. Electric lighting, which also included the use of electricity for domestic purposes, received a stimulus during the war, and at present there was no set-back, and he did not believe that any set-back was coming. In other words, electric lighting was doing fairly well at present. A fourth division of their business was that relating to motor omnibuses, in country districts more particularly. The business was not a gold mine, but there was a living in it. To be profitable it must be conducted by men who were thoroughly conversant with it, and above all it was essentially a business

that must be conducted by large companies. The profits were not such as would stand much competition, and in that respect he was inclined to think they had not got much to fear, because the 'buses had to be licensed by the local authorities. Those authorities knew their business, and he could not imagine that they were going to allow more 'buses to go and wear out their roads than the necessities and the convenience of the public required. That was a protection upon which he thought they might justly count. Their interest in the 'buses was mainly derived from their subsidiary company, the British Automobile Traction Co., and in addition they had a very large 'bus interest derived from their tramway companies. Their interest in 'buses was likely to increase as it was capable of expansion. Two of their subsidiary companies had made new issues of capital—the Shropshire Power Co., which made a very successful issue, and the British Automobile Traction Co., which was not so favourably received by the public. He thought the public was wrong there, but there was a certain justification for its attitude in that this 'bus business in rural areas was a new business. Having stated that it was the present intention of the directors, if circumstances were satisfactory, to declare an interim dividend about December next, the chairman said that as to the future, it was very difficult in a company like that with such varied undertakings to forecast exactly what was likely to happen. All he could say was that he had now had two years' experience of the company, and as time went on his regard for the company increased, and he could see no reason why it should not continue to steadily progress in the future. He was not tying himself down to an increased dividend during the coming year, but he looked forward to a steady increase in years to come.—Mr. Emile Garcke seconded the motion, which was adopted after a short discussion.

Madras Electric Supply Corporation, Ltd. The report for 1921 showed a gross revenue of £153,919, and working expenses of £74,933, as compared with £142,828 and £62,636 respectively, in 1920. Deducting £19,739 for adjustment of exchange left a balance on revenue account of £59,247, as against £81,446—a decrease of £22,199. The net revenue was £26,487. Adding to this the amount brought forward, and deducting the preference dividend, left an available balance of £30,356. This was distributed as follows:—Dividend of 8 per cent., free of tax, on ordinary shares, £15,183; additional remuneration to directors, £445; transferred to general reserve fund, £5,000; carried forward, £9,728.

In presenting the report at the annual meeting, held on June 14th, the Chairman (Mr. James Gray) pointed out that there was a loss upon exchange as compared with a gain of £1,254 in 1920. Working expenses showed a greater increase than the revenue, chiefly due to increased fuel costs and wages adjustments. Although, as predicted at the last meeting, the growth of business had received a check owing to the delay in the installation of additional converting plant, the total kW connections had been more than maintained owing to the connection of several large power consumers. With the exception of the tramways, which were affected by a strike in the early part of the year, increased supplies were taken in all directions. The Corporation was indebted to the Government of Madras for the removal of the restriction of the price increase to three years commencing August 1st, 1919. Now the tariff would be subject to the ordinary provisions of the Indian Electricity Act.

The capital expenditure on buildings and machinery during the year amounted to £29,070, this being represented chiefly by a new water-tube boiler and three new sub-stations. Mains extensions cost £21,216.

To meet the growth of demand additional generating and converting plant was being installed. This included a water-tube boiler, a 5,000-kW turbo-alternator, and 3,000 kW of rotary converters. The debenture issue to provide the funds for this plant was very successful, having been subscribed twelve times over.

In seconding the motion for the adoption of the report and accounts, Mr. J. G. B. Stone gave some particulars of his recent visit to India when he inspected the whole of the Corporation's undertaking. He said that, at present, there was not a large industrial load, probably owing to the fact that really cheap power was not available. Now that the Corporation was in a position to offer cheap power the industrial load would grow. The report and accounts were adopted and the retiring director, Mr. K. A. Scott Moncrieff, M.I.E.E., was re-elected.

Veritys, Ltd.—The financial Press reports that after providing £2,783 for depreciation, the accounts for 1921 show a net loss of £3,002. To this is added £6,300 for interim dividends paid during the year, and the credit balance of £1,656 is deducted, leaving a debit of £7,646 to be carried forward.

India Rubber, Gutta Percha and Telegraph Works Co., Ltd.—According to the *Financier* the directors regret they are unable to recommend an interim dividend on the ordinary shares.

James Keith & Blackman Co., Ltd.—Dividend on the ordinary shares at 7½ per cent., free of tax, for the year ended March, 1922. Carried forward, £15,944.

Stock Exchange Notices.—Application has been made to the Committee to allow the following to be officially quoted:—Cordoba Light, Power & Traction, 665,811 seven per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 665,811.

Johnson & Phillips, 437,500 ordinary shares of £1 each, fully paid, Nos. 1 to 437,500.

Dealings in the following have been specially allowed by the Committee under Rule 148a:—

British Thomson-Houston.—1,000,000 seven per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 1,000,000.

The undermentioned have been ordered to be officially quoted:—

Llanelly and District Electric Lighting and Traction.—50,000 6 per cent. cumulative preference shares of £1 each, fully paid (Nos. 175,001 to 225,000).

Mersey Power.—£300,000 7½ per cent. mortgage debenture stock.

Mexico Telephone (Ericsson) Co.—The report for 1921 states that the number of subscribers to the company's system again increased, and a further expansion took place in the first four months of 1922. As net profits, the accounts show a total of 724,000 Swedish kronen as compared with 677,000 kr. in the previous year, and the dividend is at the rate of 12 per cent., as against 11 per cent. in 1920. The report further states that as it appeared impossible to realise the object for which 629 shares were acquired in the Cia. Telefonica Jaliciense, the directors had again disposed of these shares.

Victoria Falls and Transvaal Power Co.—It is reported in the financial Press that the net earnings, including those of the Rand Mines Power Supply Co., for the quarter ended March 31st (which included the period of the labour disturbance) amounted to £82,559 before providing for taxation in South Africa and the United Kingdom.

A further dividend of 4 per cent., less tax, on the preference shares, making 10 per cent. for the year 1921, is announced; also a dividend of 3 per cent., less tax, on the preference shares on account of the year ended December, 1922; and a dividend of 5 per cent., less tax, in respect of 1921 on the ordinary shares.

Amalgamated Wireless (Australasia), Ltd.—At a meeting of this company, held in April, the shareholders authorised an increase of the company's capital to £1,000,000, by the issue of 800,000 ordinary shares of £1 each, paid up to 2s. in the first instance, also a resolution to amend the company's articles of association in accordance with the agreement entered into with the Commonwealth Government. The chairman, Sir Thomas Hughes, M.L.C., outlined the arrangements made with the Government and the future programme of the company.

Shropshire, Worcestershire & Stafford Electric Power Co.—According to the *Financier*, the report for 1921 states that the net receipts from sales of energy, interest and dividends on investments, &c., were £95,153. After deducting administration and general expenses, debenture and loan interest, and adding £16,183 brought forward, there remains £41,383. Dividend on 7 per cent. preference shares, £3,500; dividend on 6 per cent. preference shares, £9,000; carried forward, £27,272.

Eastern Telegraph Co., Ltd.—Dividend at the rate of 3½ per cent. per annum, less income tax, on the preference stock of the company for the quarter ending June 30th; and a first quarterly interim dividend of 2½ per cent. on the ordinary stock, free of income tax in respect of profits for the year ending December 31st, 1922.

Para Telephone Co.—Net profit for 1921, £2,482, plus £8,605 brought forward, making £11,087. The *Financial Times* says it is proposed to pay a further dividend of 3 per cent., making 6 per cent., free of tax, carrying forward £4,457.

Kidderminster & District Electric Lighting and Traction Co., Ltd.—It is proposed to pay a dividend of 2½ per cent. on ordinary shares for 1921, carrying forward £213. Kidderminster and Stourport Electric Tramway Co. is paying a dividend at the rate of 3½ per cent., carrying forward £262.

Manila Electric Corporation.—A special dividend of ½ per cent. has been declared on the common stock, for the quarter ending June 30th, 1922, making with the regular quarterly dividend of two per cent., already announced, a total of 2½ per cent., or $2.50 per share.

Barnsley & District Electric Traction Co., Ltd.—Dividend for 1921 15 per cent., £1,500 to reserve, £15,500 to special reserve for E.P.D. for 1919 and 1920, carrying forward £22,800.

Reduction of Capital.—BRITISH POWER RAILWAY SIGNAL CO., LTD., AND REDUCED.—A petition for the reduction of the capital of the company from £50,000 to £25,000 has been presented to the High Court, and will be heard in London on June 27th.

Waygood-Otis, Ltd.—Final dividend of 5½ per cent., making 8 per cent. for the year and a bonus of 2 per cent. on the ordinary shares; £40,000 to reserve; £5,000 to pensions fund; £22,339 carried forward.

Montreal Light, Heat and Power Co.—Dividends of 1¼ per cent. on the consolidated shares and 2 per cent. on the common shares are announced.

STOCKS AND SHARES.

TUESDAY EVENING.

THE reduction to 3½ per cent. in the Bank Rate had a cheering effect upon most of the Stock Exchange markets. It brought fresh investment into the consol market and gave business a fillip in other departments, more particularly in those cases where new issues have fallen to a substantial discount below the subscription prices. The banks are now paying 1½ per cent. on deposit money, and it is a matter for no little curiosity to observe how far this change in the rate will dislodge money held on deposit account by the banks. As the figures are not published, no one can do more than vaguely guess at the sums on deposit at the banks, though Stock Exchange men get daily surprises in the shape of discoveries that clients of theirs still cling to the meagre rate given by the banks, instead of investing the money in securities upon which 5 per cent. and upwards is still obtainable. The Home Railway market shook off part of the heaviness into which it was plunged by the disclosure, last contango day, of an unexpectedly heavy bull account. With regard to industrials, the tendency is better, owing to the expectation that improvement in gilt-edged markets will have the usual effect of broadening the interest in other stocks and shares, and of directing fresh capital into such investments.

Districts, despite the rally in Home Rails, are 3 points lower at 35½. The other Undergrounds are disposed to dulness. The Bill empowering the London Electric Railway and the City & South London Railway, to raise fresh capital will be passed unopposed in the House of Commons. Second debenture stock amounting to £2,250,000 will be raised by the first-named company, and £1,250,000 by the City & South London. Keen curiosity waits upon publication of the terms upon which the stock will be offered to the public.

Electricity supply shares maintain all their firmness, and this week there are rises of ½ in Metropolitan ordinary to 5⅞, and in St. James's ordinary to 8½. County of London preference at 1 1/16, are 1s. 3d. higher. The ordinary shares are quoted 25s. middle, but can be sold at a better price than this. There is a strong demand for all the shares in the list, without there being any sufficiency of supply. City Lights are better than the price suggests, being saleable at 38s. 9d., or higher. Newcastle-on-Tyne ordinary gave way to 13s. 9d. Metropolitan 7 per cent. debenture at 107 is ¼ down.

In the manufacturing group, the Edmundson's report shows a small decline on the trading surplus, but the dividend and interest income improved by £10,000 to £66,700. The disposable balance of £31,400 is about £14,000 higher than that of last year. The 6 per cent. cumulative preference shares are to have their interest up-to-date, by the payment of 12 per cent., and the 6 per cent. non-cumulative preference shares enter the dividend list with 3 per cent., this being the first distribution made for ten years. Edmundsons have added a new interest to their holdings in the shape of Tisbury Electric Supply shares. The excellence of the figures reveal how it is that for some time past there have been buyers only of Edmundson's preference, sometimes at prices well above those quoted as the nominal values. The 6 per cent. cumulative preference changed hands at 4 1/16 a few days ago, but are now 4½, and the non-cumulative, which were done at 45s. and 47s. 6d. at the end of last month, have risen to 50s. The 4½ per cent. debenture, now 5 per cent., is quoted at 74, and the ordinary shares of £3 each, fully-paid, stand at 20s. Except for the debenture stock, the issues of the company are higher to-day than they were on the eve of the outbreak of war. Cromptons at 18s. 9d. have lost 1/16. Electric Construction preference at 21s. 3d. are better. General Electrics are a little unsteady on the eve of the dividend announcement. Metropolitan-Vickers preference at 2 7/16 are 1/16 down, the ordinary, however, hardening to 25s. The engineering group show little variation. Babcock & Wilcox receded to 3. Termination of the engineers' lock-out shows clearly the damage which has been done by the dispute, many contracts having been lost, and a great many men finding themselves out of work pending such time as the employers can get works going again, and are able to take on new contracts. Brush ordinary at 25s. 9d. have gone back a little.

It is said, with more show of authority than usual, that Mexico and the United States have arrived at an agreement upon the various matters in dispute between the two countries. If so, this will open the way to peaceful relations between the two countries, and to the granting, by the United States, of the long-expected loan to Mexico that will enable the latter to rehabilitate her finances, and set her house properly in order. For this reason, Mexican Utilities, together with other bonds and securities connected with the country, are better. Mexican Light & Power common shares have risen 3, the first mortgage bonds 2, and the Mexico Tramway also are slightly firmer. Brazilian Tractions went back to 53, on disappointment that the re-entry of the shares into the dividend-paying list has failed to bring in any accession of buying. Anglo-Argentine Tramways 1st debenture dropped to 79, at which it looks a reasonably cheap investment, paying rather over 6½ per cent. on the money, and offering sound security. British Columbia stocks are rather easier. Calcutta Electric new second debenture remains at 2¼ premium, the Indian Electric scrip being ½ premium, and the Madras ¼ premium.

The feature in the cable group is a drop of £3 in Indo-Europeans to 37½. Otherwise the market is steady, the Eastern quartet holding their prices and Anglo-American deferred gaining ½, while the preferred fell a point. Marconis are quiet, the price easing off to 50s., while Marconi Marines stiffened to 1¼. The manufacturing shares show no particular change, Callenders remaining at 41s. 3d., and Henleys at 43s. 9d. Rubber shares are lumpish. The armament list remains uninteresting. "Dollar" stocks strengthened on the set-back in the value of the pound sterling, as compared with the dollar. Canadian General Electrics are higher at 88, and Shawinigans at 118½. Dealings began on Tuesday, to-day, in the ordinary and 6 per cent. preference shares of the Llanelly & District Electric Lighting Co. The prices opened at 16s. and 17s. respectively, hardening a few pence later on.

The Stock Exchange firm of Messrs. G. D. Atkin & Co. have issued the 1922 number of their well-known Manual, giving particulars of all the electric lighting, manufacturing and traction companies that are known in the Stock Exchange. The book is published for private circulation, but its 400 pages are so closely packed with clearly-compiled information that it seems a pity the book cannot be issued for general circulation.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend. 1920.	Dividend. 1921.	Price June 20, 1922.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	12	12	7½	—	£8 0 0
Charing Cross Ordinary	8	9	6¾	—	6 11 0
do. do. do. 4½ Pref.	4½	4½	3⅝	—	5 16 2
Chelsea	6	6	5⅝	—	5 6 8
City of London	14	14	38/9	—	7 4 0
do. do. 6 per cent. Pref.	6	6	22/6	—	5 6 8
County of London	8	8	1⅛	—	6 8 0
do. do. 6 per cent. Pref.	6	6	1 1/16	+ 3/16	5 13 0
Kensington Ordinary	9	10	7⅜	—	7 0 7
London Electric	2½	4	2 1/16	—	5 17 ,8
do. do. 6 per cent. Pref.	6	6	4⅜	—	6 3 1
Metropolitan	7	7	5⅞	+ ⅛	6 13 4
do. 4½ per cent. Pref.	4½	4½	3⅝	—	6 0 0
St. James' and Pall Mall	12	12	8½	+ ½	7 1 2
South London	7	7	3½	—	8 0 0
South Metropolitan Pref.	7	7	1 7/16	—	5 18 0
Westminster Ordinary	10	10	7⅛	—	6 15 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref	6	6	109½	—1	5 16 0
do. Def.	1½	34/6	23⅝	+ ⅛	7 6 0
Chile Telephone	6	6	6 1/16	—	4 15 1
Cuba Sub. Ord.	7	7	8½	—	8 4 8
Eastern Extension	10	10	18½	—	5 8 1
Eastern Tel. Ord.	10	10	187½	—	5 6 8
Globe Tel. and T. Ord.	10	10	19	—	5 5 3
do. do. Pref.	6	6	11⅛	—	5 7 10
Great Northern Tel.	24	22	30	—	7 6 8
Indo-European	10	10	37½	—3	6 3 5
Marconi	25	15	2½	— 1/16	6 0 0
Oriental Telephone Ord.	12	12	2 7/16	— 1/16	*4 16 0
United R. Plate Tel.	8	8	7⅞	—	*5 8 6
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	18½xd	—	*5 8 0
HOME RAILS.					
Central London Ord. Assented	4	4	68	—	5 17 8
Metropolitan	1½	2½	45½	—	4 19 0
do District	Nil	1	35½	—3	2 16 4
Underground Electric Ordinary	Nil	Nil	2⅜	—	Nil
do. do. "A"	Nil	Nil	6/6	—	Nil
do. do. Income	2	4	81½	—1	*4 18 0
FOREIGN TRAMS, &C.					
Anglo-Arg. Trams, First Pref.	5½	12½	3⅝	—	7 11 8
do. do. 2nd Pref.	Nil	5½	3¾	+ ⅛	7 3 0
do. do. 5 per cent. Deb.	5	5	79	—1	6 6 7
Brazil Tractions	Nil	Nil	53	—1	7 11 0
British Columbia Elec. Rly. Pcc.	5	5	80½	—	6 4 3
do. do. Preferred	6	92/-	69⅝	—1	*6 13 0
do. do. Deferred	3	124/-	73	—1½	*8 10 0
do. do. Deb.	4½	4½	79	—	5 7 7
co Trams. 5 per cent. Bonds	Nil	Nil	71½	—	—
do. do. 6 per cent. Bonds	Nil	Nil	87½	—	Nil
Mexican Light Common	Nil	Nil	22½	+ 3	Nil
do. Pref.	Nil	Nil	53	+1	Nil
do. 1st Bonds	Nil	5	75½	+2	6 12 7
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3	— ⅛	5 6 8
British Aluminium Ord.	10	10	4½	—	—
British Insulated Ord.	15	15	2⅜	—	7 1 2
Callenders	15	15	2 1/16	—	7 5 3
„ 6% Pref.	6½	6½	1 1/16	—	5 9 5
Crompton Ord.	10	10	18/9	— 1/16	10 13 4
Edison-Swan	10	—	5/-	—	—
do. do. 5 per cent. Deb.	5	5	65	—	7 13 10
Electric Construction	10	10	1 1/16	—	7 16 0
English Electric	8	8	15/-	—	6 13 4
do. do. Pref.	6	6	18/3	—	6 11 6
Gen. Elec. Pref.	6½	6½	22/9	+6d.	5 16 10
do. Ord.	10	10	21/-	—3d.	9 10 6
Henley	15	15	2 1/16	—	6 17 0
do. 4½ Pref.	4½	4½	4⅛	—	5 2 10
India-Rubber	10	—	⅛	—	—
Met.-Vickers Pref.	8	8	2 1/16	— 1/16	6 11 2
Siemens Ord.	10	10	27/-	—	*7 8 2
Telegraph Con.	20	20	26½	—	*4 11 6

* Dividends paid free of Income Tax.

WARM WORK ON METERS.

By G. E. MOORE.

The purpose of the present literary effort is to make known to the world the awkward dilemma in which I find myself. And here I am, going to write about a dilemma and not at all clear as to how I can switch on. Essayists advise one to first of all start off with a good introduction, so the best thing I can do, then (in the absence of a better mutual friend than this printed page), is to introduce myself.

I happen to be in a meter department—testing, not mere installation, I hasten to add. Yes, I know that plenty of superior people regard the meter department as a luxury branch ("a positive excrescence," to quote one critic), and that meter-work is simply a walk-over, as the saying is. That precocious young sceptic I overheard the other day asserted the belief of many when he expressed the view that "any mug can watch disks go round." (As a matter of fact, I used to think so, too.) Well, apart from the financial aspect—and regarding this my friend Fairpotts has very truly remarked that a few one-per-cents. rescued may pay our wages-bill—it is curious how many problems do turn up, and how many lines of worry and grey (or vanishing) hairs those disks do cause, to be sure. And why is it that at the end of a visit to save a batch of fractious meters (and his firm's reputation) a manufacturer's expert invariably staggers away muttering that if *he* had his time over again there's *one* thing he would *not* be, mind that? But all this is by the way.

Here I am, then, testing meters. And you will be the more impressed (I hope) when I tell you that I tackle a.c. ones, and polyphase at that. Anybody can nurse and test d.c. stuff, but when it comes to a.c.—why, that's a different proposition, you know. There is a kind of class distinction. This being so, I have to look after my status, and, as the a.c. authority, I do my best to be distinctive. For one thing, I generally appear in a hard hat and collar to match (the d.c. and other people are addicted to caps and soft collars), and my slide-rule with log-log and all sorts of other baffling scales has a most humbling effect on "the rest." When I get really thoughtful and begin to work out vector diagrams, everybody is tremendously impressed, and if it weren't for the noise of the M.G. you could hear a pin drop. On Saturday mornings (Saturday is not a Hard-hat Day with me) I relax a bit, and it is surprising how friendly the others become. Nowadays it's best to be sociable and democratic sometimes, especially as keeping up one's status is often rather a nuisance.

To come to some practical details: At my bench I have a 3-phase circuit to give anything up to 5 amps., the load being banks of carbon-filament lamps. Until last autumn it had been the practice to use reversed current transformers for testing meters of greater amperage than five—*i.e.*, a 10/5 C.T. was used with a 10-amp. meter and actually acted as a 5/10 C.T. The banks of lamps and the current transformers, as will be seen hereafter, are really the cause of all the bother, and, incidentally, the infliction of this heartrending account.

Now that the stage is set, we can raise the curtain and present the opening scene. Time: Last October. The Chief enters and, whilst prowling around in his usual way, sees the reversed transformers in use. "Oh, by the way," says he, "I've been thinking that those transformers must mess the wave-form about a lot." I look as thoughtful and intelligent as I can. "Now, what can we do if we do do without 'em?" he goes on. I begin, in a vague sort of way, to glance around the test-room. "Ah, I've got it," he says suddenly. "Down in the stores you'll find three radiators. Put one in each phase to augment those lamps. And throw those beastly transformers away." I place the transformers on the stock-shelf and hie me to the Stores.

That is how I came to have three radiators in my corner, and as you can have no idea of the consequences (fearful and otherwise) of the Chief's brain-wave, I am going to enlighten you. Of course, as a load expedient the radiators have behaved admirably—I must say that. But just let me tell you some of the incidental results. In the first place the Storekeeper's former friendliness turned into deep and abiding enmity. No longer would he vouchsafe a cheerful and respectful "Good morning" on my Hard-Hat Days, and the gifts of odd rolls of insulating tape and lengths of "flex." abruptly ceased. This strange and disturbing change puzzled me for a long time until I recollected that when I went for the radiators they were out of sight behind a camouflage of sacking and cable-drums, *and that during the previous winter the Storekeeper had basked in their glow*! Hence the diplomatic rupture, you see.

Well, winter was coming along, and I must confess that those three radiators made the place exceedingly comfortable. Unfortunately, they made my corner popular—far too popular—and visits became more and more frequent, the departures more and more reluctant. And presently I found my intellectual isolation a thing of the past, though I wore my hard hat and "choker" every day, and wrestled with vector diagrams with greater frequency than ever, and nearly made my patent slide-rule red-hot into the bargain. As each visitor lingered, it seemed quite the thing (now that Awe and Respect were no more) to make some footling remark or other, to which, with rage nearly choking me, I was bound to reply. Soon I found, first through my own comfort and then *vid* other people's, that half- and full-

"Warm Work on Meters."

lead tests on big-ampereage meters were to be thoroughly recommended. On particularly frosty mornings one could not help putting on an overload just to see how rapidly the meter curve would fall off, while, on the other hand, twentieth load met with a chilly reception.

The installation of those radiators resulted in a revisal of test-room habits. Hitherto the d.c. testers and the meter-repairers (whose lunch-hour differs from mine) repaired to a remote spot in the building, but one by one they drifted into the neighbourhood of the radiators, and daily I began to be bothered by the sounds of lunch being tackled by many jaws. How could I possibly work out intricate things like power-factors and the "K" of a meter with *that* going on, and with football matches being re-fought and the Premier's reputation torn into shreds every day? I once tried dropping to about one-hundredth load in the hope that they would be frozen out, yet they continued to sit there so patiently and optimistically that I hadn't the heart to work a-

less than half-load. And whenever there did not happen to be a test running any lunch-hour—why, I felt so apologetic that I just kept out of sight. One day a go-ahead chap made some toast. Next day (not to be beaten) his mate turned up with a pie, which he proceeded to warm on a radiator; a few minutes later there was a tremendous CRACK! and then a fearful flare-up. The stench persisted all the afternoon, and the Chief, happening to come in, wandered around, saying that he was *certain* (sniff!) some insulation (sniff!) was burning somewhere (sniff, sniff!). I did get two laughs out of the radiators. One was when Old Jock singed his whiskers whilst lighting his pipe, and the other when a fuse blew during the gastronomic performance and caused quite a lot of diverting complications. But on these occasions I had to finish my laughs outside owing to the unreasonably hostile attitude of the victims.

Other difficulties I had to contend with during the winter months included the hanging-up of sundry coats, caps, and even socks in wet weather; also the practice of drying-out coils and the like in front of my radiators. You would be astonished at the amount of unreasonableness displayed whenever I had the callousness not to use the radiators! And if the Chief paid a visit, and the radiators were "on," he must needs sit down and make himself thoroughly comfortable and affable. His presence was most disturbing—Chiefs shouldn't do such things, you know. However, I thought of a brilliant idea for dislodging him. I jolly soon dropped to low load. This was one of my exceptional ideas. It worked!

Well, in due course, spring came along (according to the calendar at any rate), when, although there were no signs of wintry conditions changing, I began to look at those radiators with a certain amount of foreboding. I felt the least bit uneasy. I wondered just how warm the place would be at midsummer. As the days went by I began to be physically conscious that things *would* be rather on the warm side, and it seemed to me that, on the whole, three-quarter and full-load tests were not really of much use. After all, what more do you want if 5 per cent. and 50 per cent. loads are OK? But (worse luck) there would still be the half-load test with p.f. of 0.5.

By degrees the position has gone from bad to worse. The place now becomes so warm that my lunch-hour friends have retired into the remote fastness they patronised of old. The Chief's visits are now so brief as to require no special cooling treatment; while the Storekeeper (who came in the other day and seemed quite interested in my hot and flurried appearance) has recovered his old respectfulness and generosity. I really think I am getting back my former status. And yet, in spite of this, I don't feel as elated as I should. With those confounded radiators here this intellectual isolation business is a mixed blessing. The plain fact of the matter is that it's getting hotter and hotter every day and more big-ampereage meters than ever are coming in. Just picture me sweating away in a tropical atmosphere with thousands of lumens and therms (not to mention cuss-words of a markedly sultry nature) flying about. And summer is nearly here!

Well, it's not good enough. I'm getting fed-up. Yes, I *have* tried rigging up an electric fan, but thanks to the radiator elements having a temperature coefficient this gave nice, unsteady loads—of no use to me. One of these days (a Hard-Hat Day preferably) I'll get on the high horse and go and have a straight talk to the Chief. I'll tell him point blank, I will, that if he can't have the radiators shifted half-a-mile or so then we should adopt the current transformers again and let the wave-form go hang during the hot weather. For this is what it will come to: I'll have to put on shorts and a pith helmet to test those darned meters, and that's a thing no man with a Status would do. I'm pretty far gone as it is, and there's no guarantee that I'd last out the summer even then. And that's that!

THE TURN OF THE TIDE IN SWEDEN.

"The opportunity for the development of British trade in Sweden was never so favourable. Great Britain is the most lucrative market for Swedish goods, and it is realised here (in Sweden) that a larger importation of British goods would probably in the long run lead to an increase in Swedish export trade to Great Britain."

This encouraging statement is contained in the recent report by H.M. Commercial Secretary at Stockholm (Mr. H. Kershaw).* It is apparently based on the fact that the keen edge of German competition in Sweden has been dulled by failure to adhere either to quoted prices or delivery promises. The opportunity for British exporters has been further improved since Mr. Kershaw's report was written owing to the revival which is evident in the timber and allied industries in Sweden as a result of wages adjustment.

German Competition.

Regarding German competition, the Commercial Secretary points out that the Germans have been in the habit for many years of studying this lucrative market with meticulous care, and, with characteristic thoroughness, they are planning a powerful campaign to regain their hold on Swedish business. Prolific German trade advertisements appear constantly in the Swedish press, some papers containing as many as four and five whole-page "group" advertisements in a single issue. The country has been crowded with German travellers, many agencies have been started, and proposals have been made for establishing a German commercial inquiry bureau and permanent sample exhibition in Stockholm. However, the dissatisfaction in Sweden with German methods, especially on the score of defective deliveries, repudiation of contracts, and the very irritating habit of increasing prices after orders have been placed (owing to the collapse of the mark), has become acute, and matters are not likely to improve in Germany's favour when the internal value of the mark begins to rise.

* Department of Overseas Trade.

War-time Engineering Developments.

The report has some interesting notes on war-time developments in Swedish engineering production. In view of the expansion of Swedish manufacturing industries during the war, there was a large increase in the use of cranes, hoists, &c., but owing to the difficulty of procuring supplies from abroad much of this machinery was manufactured in Sweden. Large quantities of cranes (especially for harbour work) and other conveying appliances have been imported from Germany, and it is principally German competition which British manufacturers will have to face. In normal times Sweden is a fairly large and steady consumer of conveying machinery. It is used at the mines and foundries, saw mills, pulp and paper mills. Moreover, a large number of 2½-ton and heavier cranes have already been installed, and more will be required in connection with the important "free" and other harbour developments at Stockholm, Gothenburg, Malmö, &c.

There has been a severe slump in the machine tool trade for some considerable time, owing to the depression in the Swedish manufacturing industries. Normally, there is a steady market in Sweden for machine tools, but the fact cannot be ignored that the Germans have developed the market with scrupulous care by adapting their machines, tools and gauges to Swedish requirements. Moreover, every inducement was offered in the past by way of long credits, and in some cases engineering firms were allowed to effect payment by instalments over a period of twelve months, and even longer. Some exporting firms adopt the device of keeping a permanent travelling technical expert in Europe, whose duty it is to make workmen thoroughly acquainted with the mechanism of the machine tools installed. By this means a good foundation is laid, and it has resulted in the placing of many repeat orders. There ought to be good openings in due course, especially for plate bending machines, the heavier types of shearing and drilling and stamping machines, high-class lathes, &c., &c. Although orders are often sent direct by the user to the manufacturer, it is nevertheless a good plan to have on the spot a thoroughly competent agent who is in constant personal touch with shipbuilders and other engineering establishments. At present

importers and merchants are saddled with fairly heavy stocks of standard machines, and these will have to be reduced before further imports take place on any considerable scale.

Although woodworking machinery is manufactured in Sweden, the Germans are making many varieties, which have been imported in considerable quantities to the detriment of local production. It is unfortunate, says the Commercial Secretary, that in spite of their excellent reputation, British woodworking machines do not appear to be very well known in Sweden. A considerable trade could probably be worked up in special lines if vigorous steps were taken to bring them to the notice of users.

Standardisation. The question of standardisation in industry is engaging the serious attention of manufacturers. The Swedish Engineering Standardisation Bureau, for instance, is working in collaboration with standardisation organisations in other countries and has taken part in international conferences. The Swedish electrical industry possesses its standardisation committee, and is engaged in fixing standards for a large number of electrical materials.

Railways and Electrification. Owing to the financial depression, certain schemes which blossomed during the period of unexampled prosperity have had to be modified or abandoned; in particular, the electrification of the main line between Stockholm and Gothenburg, which would have involved a very large expenditure. The phenomenal drop in the prices of coal may also be regarded as a contributory factor to this decision. The electrification of the line between Kiruna and Svartön is, however, being proceeded with, and will, it is expected, be completed in 1922.

The question of railway communication between Sweden and Norway is constantly engaging the attention of the respective authorities. During the year, a mixed commission, comprising delegates of the Swedish and Norwegian Governments, was appointed to consider, *inter alia*, the improvement of communications between the two countries, *via* Bohuslän.

Telegraphy and Telephony. In wireless telegraphy, the outstanding feature in 1921 was the examination by the Telegraph Administration of the important project for the erection in Sweden of a high-power station which, it is claimed, will be one of the largest in the world, inasmuch as it will be equipped for the transmission and reception of messages to and from the American Continent. British, French, American and German systems were examined by experts. The Swedish authorities, however, decided to suspend the placing of the order for this high-power station until the financial position improved. The site of the new station has not been definitely chosen, but it will probably be situated on the South Coast. Other wireless developments are to be traced in preliminary discussions which have taken place for the linking-up of Sweden and Finland by wireless. During the year an important co-operative agreement was concluded between the Marconi wireless interests and the Swedish Radio Co., of Stockholm, for the development of wireless telegraph business in Sweden.

As is well known the use of the telephone has reached a high state of development in Sweden. During 1921 a telephone cable was laid between Sweden and Germany, and work is rapidly proceeding with the installation of another telephone cable between Stockholm and Gothenburg, passing through Köping, Västeras, Orebro, Skövde and Allingsas. Telephonic communication between the two principal Swedish cities is rapidly on the increase, and the completion of the cable is, therefore, anxiously awaited. Serious attention is being paid to the possibilities of the practical use of the wireless telephone. The Commercial Secretary mentions the important fusion which was arranged between the L.M. Ericsson General Telephone Co. and the H.T. Cedergren General Industrial Co., manufacturers of telephone wires and cables. This amalgamation was brought about for the purpose of effecting considerable economies and to increase the competitive value of the Swedish telephone industry.

ELECTRICITY AND MATTER.

By SIR ERNEST RUTHERFORD, F.R.S.

(Abstract of thirteenth KELVIN LECTURE, *delivered at the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE proof of the atomic nature of matter, the dimensions of atoms and molecules, including the first suggestions of the mechanism of atomic constitution was a subject in which Kelvin was permanently interested. While keenly interested in such speculations, there remained the curious anomaly that he did not entirely accept the current explanation that radioactivity was a consequence of the successive disintegration of atoms.

The discovery in 1897 of the individual existence of the negative electron of small mass, and the proof that it was a component of all the atoms of matter, was an event of extraordinary significance to science.

The first definite proof of the close relations that exist between electricity and matter we owe to the famous experiments of Faraday on the passage of electricity through electrolytes. It was clear that the simple numerical relations found by him between the electro-chemical equivalents of the elements and their atomic weights could be simply interpreted by assuming that electricity was atomic in character and that the charges carried by the individual ions were integral multiples of a fundamental unit of charge. The suggestion was mentioned by Maxwell and Helmholtz, although with reservation, but was revived with conviction by Johnstone Stoney, who suggested that the name "electron" should be applied to the fundamental unit of electricity, and made a rough estimate of its magnitude. The term "electron" is now used to denote, not the actual value of the unit of charge, but the free atom of negative electricity. Townsend found that the charge carried by the ions produced in gases and by the electron itself was numerically equal to that carried by the hydrogen ion in the electrolysis of water, which was taken as the fundamental unit. By balancing the weight of a charged drop by the attraction of the electric field, Millikan was able to give a convincing proof of the correctness of this view and to determine the magnitude of the fundamental unit with great precision. Knowing the value of this constant, the electrochemical data gave us immediately the mass of the atom of all the elements. The atomic nature of matter is in reality a consequence of the discrete nature of electricity, for all the evidence indicates that the atom itself is a purely electrical structure.

While most of the carriers of electricity or ions in gases have a unit charge, in a few important cases they carry multiple charges. A well-known example is the swift α particle from radium which always carries two units, while some of the ions produced in intense electric discharges through vacuum tubes carry multiple charges.

It was soon recognised that the negative electron of small mass was an actual disembodied atom of electricity and that its apparent mass was electrical in origin. J. J. Thomson had early shown (1881) that a charged body in motion behaved as if it had an additional electric mass due to its motion. The moving charge generates a magnetic field in the space surrounding it, resulting in an increase of energy of the moving system. This additional energy is equivalent to the effect produced by an increase of the mass of the body. The experiments of Kaufmann and others on the swift electrons ejected from radium showed that the mass of the electron, while sensibly constant for slow fields, increased rapidly as the velocity of the electron approached that of light. This variation of mass was in good agreement with calculations based on the electrical theory. Later, Einstein from considerations of relativity showed that for any material particle, whether charged or not, the mass m must vary with speed according to the relation $m/m_0 = (1 - \beta^2)^{-1}$, where m_0 is the mass for low speeds, and β is the ratio of the velocity of the particle to the velocity of light. Experiment has been shown to agree closely with this calculation. Only a small fraction of the mass of an atom can be ascribed to the negative electrons contained in it, the main part is to be ascribed to the positively charged units of its structure. One of the main difficulties in our attack on the question of atomic constitution has lain in the uncertainty of the nature of positive electricity. The evidence as a whole supports the idea that the nucleus of the hydrogen atom, *i.e.*, a positively charged atom of hydrogen, is the positive electron. No evidence has been obtained of the existence of a positively charged unit of mass less than that of the hydrogen nucleus, either in vacuum tubes or in the transformation of the radio-active atoms, where the processes occurring are very fundamental in character.

The positive and negative electrons both consist of the fundamental unit of charge, but the mass of the positive is about 1,800 times that of the negative. This difference seems a fundamental fact of nature and, indeed, is essential for the existence of atoms as we know them. The unsymmetrical distribution of positive and negative electricity that is characteristic of all atoms is a consequence of this wide difference in the mass of the ultimate electrons which compose their structure. It has been proposed that the name

"proton" should be given to the unit of positive electricity associated in the free state with a mass about that of the hydrogen nucleus, viz., about 1.007 in terms of O = 16.

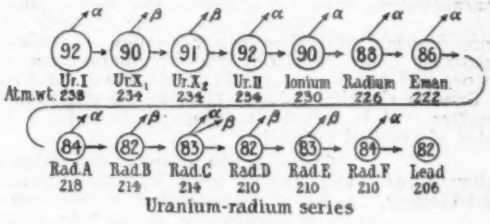
On the classical electrical theory, the mass of the electron can be accounted for by supposing that the negative electricity is distributed on a spherical surface of radius about 1×10^{-13} cm. In some recent theories of Compton and others it has been supposed that the electron behaves like a flexible ring whose dimensions are about 10^{-11} cm, or about 100 times the original estimate, but what little experimental evidence there is seems to me to support the older estimate of size. Taking the view based on the older theory, the greater mass of the proton is to be explained by supposing that the distribution of electricity is much more concentrated for the proton than for the electron. Supposing the shape spherical, the radius of the proton should be only 1/1800 of that of the electron. The proton and the electron are the fundamental units of which all atoms are built. The atom is an electric system and the atoms of all the elements have a similar type of structure. The nuclear theory of atomic constitution is now generally employed in all detailed theories of atomic constitution. At the centre of each atom is a massive positively-charged nucleus of dimensions minute compared with the diameter of the atom. This nucleus is surrounded by a distribution of negative electrons which extend to a distance and occupy rather than fill a region of diameter about 2×10^{-8} cm. Apart from the mass of the atom which resides mainly in the nucleus, the number and distribution of the outer electrons, on which the ordinary physical and chemical properties of the atom depend, are controlled by the magnitude of this nuclear charge. The position and motions of the external electrons are only slightly affected by the mass of the nucleus. On this view of the atom the problem of its constitution naturally falls into two parts, one the distribution and mode of motion of the outer electrons and the other the structure of the nucleus and the magnitude of the resultant positive charge carried by it. In a neutral atom the number of external electrons is obviously equal to the number of units of positive (resultant) charge on the nucleus.

The general conception of the nuclear atom arose from the need of explanation of the very large deflections experienced by swift α and β particles in passing through the atoms of matter. A study of the number of α particles scattered through different angles showed that there must be a very intense electric field within the atom, and gave us a method of estimating the magnitude of the charge on the nucleus. Similarly the scattering of X-rays by the outer electrons gave us an estimate of the number of these electrons in the atom, and the two methods gave concordant values. The experiments of Moseley on the X-ray spectra of the elements received a simple explanation if the nuclear charge varied by one unit in passing from one atom to the next. In addition, it was deduced that the actual magnitude of the nuclear charge of an atom in fundamental units was equal to the atomic or ordinal number when the elements were arranged in order of increasing atomic weight. On this view the nuclear charge of hydrogen is 1, of helium 2, lithium 3, and so on up to the heaviest element, uranium, of charge 92. Between these limits, with few exceptions, all nuclear charges are represented by known elements.

The properties of an atom are defined by a whole number, which varies by unity in passing from one atom to the next, which not only represents the ordinal number of the elements but also the magnitude of the charge of the nucleus and the number of outer electrons. It could hardly have been anticipated that possibly, with few exceptions, all nuclear charges between 1 and 92 would represent elements found on the earth. With the exception of the radio-active elements the atoms are all stable for intervals represented by millions of years. The atomic weight of an element is not nearly so fundamental a property of the atom as its nuclear charge, for its weight depends upon the inner structure of the nucleus, which may be different for atoms of the same nuclear charge.

Electrons are arranged in groups or shells round the nucleus. Bohr has attempted to deduce the distribution and mode of motion of the electrons of all atoms. The position and motion of the electrons are determined by certain relations based on the quantum theory. The whole problem is one of very great difficulty and complexity when we recall that the atom of a heavy element like uranium contains 92 electrons which are believed to be in rapid motion round the nucleus. The theory offers a general explanation of the periodic variation in the properties of the elements, and even accounts for the presence of the group of rare earths where the chemical properties of successive elements closely resemble one another. It endeavours to account, not only for the light spectra, but also for the X-ray spectra of all the elements. While it is too soon to express a definite opinion of how far this theory is capable of explaining the great multitude of facts known about the elements, there can be no doubt that a substantial advance has been made in the attack of this most fundamental of problems which lies at the basis of physics and chemistry.

The most definite information in the direction of the structure of the nucleus has been obtained from a study of the modes of disintegration of the radio-active atoms. In the great majority of cases the atoms break up with the expulsion of a single α particle, which represents the doubly-charged nucleus of the helium atom; in other cases a swift β ray or electron is liberated. That these particles are liberated from the nuclei of the radio-active atoms is clearly shown by the variation of the atomic numbers of the successive elements in the long series of transformations of uranium and thorium (see fig. 1). The expulsion of an α particle lowers the nuclear charge of the atom by two units and its mass by four, while the expulsion of an electron raises it by one. On this simple basis we can at once deduce the atomic number and, consequently, the general chemical properties of the long series of



Uranium-radium series

radio-active elements. In this way we can understand at once the appearance in the radio-active series of isotopes, *i.e.*, elements of the same nuclear charge, but different atomic masses. The existence of isotopic elements was first brought to light from a study of the radio-active elements. For example, radium B, radium D, and the end product uranium-lead are isotopes of lead of nuclear charge 82, but of masses 214, 210, and 206 respectively. As regards ordinary chemical and physical properties, they are indistinguishable from one another, differing only in properties that depend on the nucleus, *viz.*, atomic mass and radio-activity. For example, radium B and radium D both emit β rays, but with different velocities, while their average life is widely different. Uranium-lead, on the other hand, is non-radioactive. Many similar examples can be taken from the thorium and actinium series of elements. These illustrations show clearly that elements may have almost identical physical and chemical properties and yet differ markedly in the mass and structure of their nuclei.

From the radio-active evidence it seems clear that the nuclear structure contains both helium nuclei and electrons. In the uranium-radium series of transformations eight helium nuclei are emitted and six electrons. It is natural to suppose that the helium nuclei and electrons that are ejected act as units of the nuclear structure, and that the nuclear charge of an element is the excess of the positive charges in the nucleus over the negative. It is a striking fact that no protons (H nuclei) appear to be emitted in any of the radio-active transformations, but only helium nuclei and electrons.

Aston's experiments show the existence of isotopes in the ordinary stable elements by the positive-ray method. He found that a number of the elements were simple, and contained no isotopes. Examples of such "pure" elements are carbon, nitrogen, oxygen, and fluorine. It is significant that the atomic weights of these elements are nearly whole numbers in terms of O=16; on the other hand, elements such as neon, chlorine, krypton, and many others, consist of a mixture of two or more isotopes of different atomic masses. Aston found that within the limit of error—about 1 in 1,000—the atomic weights of these isotopes were whole numbers on the oxygen scale. This important result suggests that the nuclei of elements are built up by the addition of protons of mass nearly one in the nuclear combination.

From the mass of an atom we can calculate at once the number of protons and electrons in its nucleus. For example, the oxygen nucleus of mass 16 and nuclear charge 8 must contain 16 protons and 8 electrons. It seems probable that the protons are not in the free state in the nucleus, but combine to form very stable helium nuclei each composed of 4 protons and 2 electrons. On this view oxygen may consist of 4 helium nuclei as secondary units while fluorine of mass 19 and charge 9 may be made up of 4 helium nuclei and, in addition, 3 protons and 2 electrons.

Disintegration of Elements.

What direct evidence is available to prove that the proton exists as a unit of the structure of the nucleus? In the radio-active transformations only helium nuclei and electrons are ejected, but no protons. The obvious method of obtaining some evidence on this point is to effect the disintegration of some of the ordinary elements and to examine the masses and charges of the ejected fragments. The most concentrated source of energy known to us is the swift α article expelled from radium or thorium. It is liberated with a velocity of about 10,000 miles per second, and has so much energy that it produces an easily visible flash of light on striking a crystal of zinc sulphide. In order to test whether the atoms can be artificially disrupted I have, therefore, employed a stream of α particles to bombard the atoms of the material under examination. On account of the minute size of the nucleus an α particle only occasionally gets near enough to the nucleus to effect its disruption. If we take a heavy atom of high

nuclear charge the repulsive forces between the positively-charged α particle and nucleus are so strong that the α particle is either turned back or loses much of its energy before it reaches the nucleus. In the case of light atoms of low nuclear charge the α particle probably retains much of its energy on entering the nucleus structure, and may be thus more effective in promoting disintegration than in the case of the heavy atom.

Regarding the effects observed when an α particle collides with the hydrogen nucleus—the lightest and simplest nucleus known to us—when α particles are passed through hydrogen or any material containing hydrogen, occasionally an α particle passes so close to a hydrogen nucleus that it sets it in swift motion. This H particle has sufficient energy to be detected by the scintillation it produces on a zinc sulphide screen. That the maximum speed communicated to an H nucleus should be 1.6 times the velocity of the colliding α particle has been verified experimentally, and it has been found that the maximum range of the recoil H particle, *i.e.*, the distance travelled in air before absorption, is about four times that of the colliding α particle. For example, if the H nuclei are set in motion by α particles from radium C of range 7 cm. in air, their maximum range is about 28 cm., but, of course, particles of all ranges from 0 to 28 cm. due to oblique collisions are also present. These swift H nuclei are liberated, not only from hydrogen, but from all matter containing hydrogen in chemical combination, and in number proportional to the amount of hydrogen.

The first observation indicating the disruption of the nitrogen nucleus was made some years ago. When a stream of α particles is passed through oxygen or carbon dioxide a few long-range particles are observed, which appear to be H nuclei liberated from hydrogen present in the radio-active source. When dry air or pure nitrogen is used the number of particles is three or four times as numerous and of greater average range. These swift particles are bent in a magnetic field as if they were hydrogen nuclei, and it was thus concluded that they arose from the disruption of the nitrogen nuclei due to close collisions with α particles.

Further progress has depended mainly on improving the methods of counting the weak scintillations produced by these particles. Dr. Chadwick and I have made a systematic examination of a number of the lighter elements, and have found that similar long-range particles are liberated from boron, fluorine, sodium, aluminium, and phosphorus, as well as from nitrogen. The range of the particles in all cases is greater than that of the H particles liberated from free H atoms under similar conditions. For example, using radium C as a source of α rays, the range of the H nuclei is about 28 cm. Under similar conditions the range of the particles from nitrogen is 40 cm., while the range of the particles from aluminium is as much as 90 cm. The range of the particles of the other elements mentioned lies between these two values. Such results show clearly that the presence of these particles cannot be ascribed to some contamination of the material with free or combined hydrogen.

In some recent experiments we have found that these long-range particles are bent in a magnetic field as if they were hydrogen nuclei, and there can be little doubt that they consist of hydrogen nuclei in all cases. The maximum speed of emission of these nuclei depends on the speed of the bombarding α particle, and varies from element to element.

Thus "protons" have been ejected from the nuclei of certain light elements by the action of the α particles. It is significant that no protons are liberated from elements like carbon (12) and oxygen (16) whose atomic weights are given by $4n$, where n is a whole number. Protons are only observed in elements where the atomic weights are expressed by $4n+a$, where a is 2 or 3. This is simply illustrated in Table I. of elements from which protons are liberated. Boron contains two isotopes which are included in the table.

TABLE I.

Element.	Mass.	$4n+a$
Boron	10	2×4+2
	11	2×4+3
Nitrogen	14	3×4+2
Fluorine	19	4×4+3
Sodium	23	5×4+3
Aluminium	27	6×4+3
Phosphorus	31	7×4+3

These results suggest that the elements are in the main built up of helium nuclei, mass 4, and protons. The α particle is unable to liberate a proton from elements like carbon or oxygen which are built up entirely of helium nuclei as secondary units, but can do so from an element like fluorine, which presumably is built up of four helium nuclei and three protons. The helium nucleus is so stable a structure that it is probably impossible to effect its disintegration with the swiftest α particle available. Since the speed of the proton expelled from aluminium, for example, is dependent on the speed of the colliding α particle, the results indicate that the proton which is liberated is a satellite of the main nucleus. Under such conditions it may be possible for the α particle to transfer much of its momentum and energy to the proton and to release it from the system to which it is bound. Such a view is supported by the rather surprising observation that the protons from aluminium—and also from other elements—are ejected in the backward as well as in the forward direction of the α particle. Such an effect is not observed when α particles collide with free H nuclei, and the expulsion of protons in all directions seems to be a characteristic phenomenon of disintegration of nuclei. Such a result receives a simple explanation if it be supposed that in some cases the α particle collides with the proton in such a position that the latter recoils in the forward direction, while in others the proton is driven towards the main nucleus of the atom, describes an orbit round it under the influence of the strong central forces, and emerges again in the backward direction.

Such a point of view is in good accord with the experimental evidence. If the protons circulate as satellites in orbits round the main positively-charged nucleus, the forces between positively-charged particles must be attractive at these minute distances. The rapid change in the laws of force and, possibly, also in the nature of the forces close to the nucleus, has also been observed in the collision of α particles with H nuclei, and has recently been investigated by Chadwick and Bieler.

It should be borne in mind that the disintegration effected by α particles is on a very minute scale. Only two protons are liberated from aluminium for a million α particles traversing it. This disintegration has been observed only by the utilisation of such a sensitive method that the individual proton can be counted. In some cases the energy of the expelled proton is greater than that of the α particle which liberates it. For aluminium the proton has a maximum energy about 40 per cent. greater than that of the α particle. There thus appears to be a gain of energy in some cases, presumably derived from the nucleus.

From the radio-active evidence we know that the nuclei of heavy atoms are built up, in part at least, of helium nuclei and electrons, while from the experiment outlined above it seems clear that the proton can be released from the nuclei of certain light atoms. It is, however, very natural to suppose that the helium nucleus which carries two positive charges in a secondary building unit composed itself of a close combination of protons and electrons, *viz.*, four protons and two electrons.

From the point of view of simplicity such a conception has much in its favour, although it should be mentioned that it seems at the moment impossible to prove its correctness. If, however, we take this structure of the helium nucleus as a working hypothesis, certain very important consequences follow. On the oxygen scale the helium atom has a mass very nearly 4.000, while the hydrogen atom has a mass 1.0077. The mass of the helium atom is thus considerably less than that of four free H nuclei. Disregarding the small mass of the electrons, in the formation of 1 gram of helium from hydrogen there would be a loss of mass of 7.7 milligrams.

It is now generally accepted that if the formation of a complex system is accompanied by the radiation of energy E, the reduction of the mass m of the system is given by $E=mc^2$, where c is the velocity of light. This relation between mass and energy follows not only as a direct consequence of the theory of relativity, but can be directly derived from Maxwell's theory, as pointed out by Larmor. On this relation the energy E liberated in the formation of 1 gramme of helium from hydrogen is equal to 6.9×10^{-18} ergs or 1.6×10^{11} gramme-calories. This is an enormous amount of energy, large compared even with the total energy emitted during the complete disintegration of 1 gramme of radium and its products, viz., about 3.7×10^{9} gramme-calories. It can be simply calculated that the energy radiated in forming one atom of helium is equivalent to the energy carried by three or four swift α particles from radium. On this view we can at once understand why it should be impossible to break up the helium nucleus by a collision with an α particle. In fact, the helium atom should be by far the most stable of all the complex atoms.

Perrin and Eddington pointed out that in all probability the energy of radiation from our sun and the stars is mainly derived from the enormous emission of energy accompanying the formation of helium from hydrogen. If this be the case it is easy to show that sufficient energy can be derived from this source for our sun to radiate at its present rate for several thousand million years. The older theories of Kelvin and Helmholtz, where the heat of the sun is ascribed to the gradual concentration of the material under gravity, make the life of the sun much shorter than modern estimates of the age of the earth, and appear to be quite inadequate to provide the requisite energy.

This interesting suggestion of the probable origin of the greater part of the enormous energy radiated by the sun and stars is one of the first-fruits of the investigations on the structure of atoms. It is believed that the formation of helium from hydrogen occurs under certain conditions in the great central furnace of the sun and stars. There is no evidence, so far, that this combination can be produced under laboratory conditions. It may be that it can be effected only under conditions of very high temperature and enormous intensity of radiation, such as occur in the interior of a sun. Even then the process of formation may go on at a very slow rate and for periods measured by millions of years.

During recent years unexpectedly rapid advances have been made in our knowledge, but we have only made a begin-

ning in the attack on a very great and intricate problem. Great difficulties arise the moment we consider why the nucleus of an atom holds together, because the ordinary laws of force between electrified particles break down at such minute distances. A closer study of the modes of transformation of radio-active bodies, where the process of devolution of elements takes place before our eyes, may be expected to give us much more important data. The general evidence indicates that the γ rays like the α and β particle have their origin in the nucleus. The study of the γ rays thus gives us information of the frequency of vibration of the electrons which form part of the nuclear structure. In addition, Ellis has shown that it appears probable that the laws of quantum dynamics which govern the motions and vibrations of the outer electrons apply also to the nuclear electrons. If this conclusion can be verified it offers the hope that we may later be able to form some idea of the detailed structure of nuclei. Harkins has pointed out relations that appear to exist between the relative abundance of elements in the earth and their atomic number, while the close study of stellar evolution should ultimately throw much light on the general problem.

POWER SUPPLY FOR THE SOUTH-EASTERN AND CHATHAM RAILWAY.

ELECTRICITY COMMISSIONERS' INQUIRY.

(*Continued from page* 863.)

The chief point of interest arising out of the proceedings on June 12th, which, by the way, were held at the Institution of Electrical Engineers, was that the only other offer which will be laid before the Commissioners to supply the South-Eastern Railway Co. with power will be that of the County of London Electric Supply Co., neither the London Companies' Joint Committee, nor the Conference of Local Authorities, or the London County Council will now suggest that they can give the Railway Co. a supply.

Before this point was reached, however, the Commissioners had sent for a representative of the Advisory Committee, under the Trade Facilities Act, and Mr. W. J. Sainsbury attended. This gentleman said that an application had also been received from the West Kent Co. for a guarantee under the Act, and the company had been informed that the Committee would not be prepared to give a guarantee for an amount of debentures in excess of the paid-up capital, and that if the works eventually cost more than was contemplated the West Kent Co. must be in a position to make up the deficiency. Moreover, one of the conditions to any such guarantee would be that the West Kent Co. must have entered into a satisfactory arrangement with the South-Eastern Railway Co. for giving that company a supply of power.

The CHAIRMAN asked what the position would be if the Commissioners refused consent to the Railway Co. to erect a generating station?

Mr. SAINSBURY said it would simply be a matter of arithmetic to decrease the amount of the guarantee, and would really bring the matter back to the original position, when the Railway Co. asked for a guarantee of £5,000,000 for equipping the lines. He was satisfied that the Committee would give the guarantee for the reduced amount under those circumstances provided satisfactory arrangements were made for a supply of power. He saw no reason why there should be any delay on the part of the Committee in making this amendment.

Sir HARRY HAWARD asked if it were the fact that a condition of these guarantees was that all contracts must be on a competitive basis and that all orders must be placed in Great Britain?

Mr. SAINSBURY said the Committee was prepared to agree to a small proportion of the money being spent outside the country where particular plant or apparatus could not be obtained here, but generally, the position was as Sir Harry had stated. In answer to another question, witness said that at present a Government guaranteed loan ought to be raised at slightly under 5 per cent. In some cases, without the Government guarantee, companies might not be able to raise money at all.

Mr. TYLDESLEY JONES, K.C., for the West Kent Electricity Co., then intimated a few drafting alterations to the proposed agreement put in on Friday, with the object of making the intention clear. For instance, the 89 million kWh mentioned was to be at a load factor of 35 per cent., taken over an hour or half an hour, and not momentarily. Then the coal clause was intended to take coal at 15s. per ton as the basis, and the wages clause took the present wages as the basis. Further, the rebate was intended to apply not only to whole numbers, but to fractions. Thus there would be a rebate of 3 per cent. when the railway load reached 89 million kWh per annum, and the general load 219 million kWh per annum, and lower proportionate rebates at earlier stages.

The CHAIRMAN suggested that the proposal should be put in a clearer form than that in which it now stood.

Sir HARRY HAWARD said there was nothing in the proposal as to the conditions under which it could be terminated. What might be a proper price now might not be a proper price some years hence.

Mr. TYLDESLEY JONES said that a revision was not a part of the offer. There was the automatic adjustment for coal and wages. Continuing, Mr. Tyldesley Jones said that the West Kent Co. would not be averse to a purchase clause, exercisable not earlier than 60 years hence, on suitable terms. The terms which it would be prepared to consider were five years' notice of purchase, the terms of purchase being 20 years' purchase of the average profits during the five years preceding purchase, subject to some safeguard against these five years, or one or more of them, proving to be abnormal. The case they had in mind had occurred with regard to the purchase by the Torquay Corporation of the Newton Abbot Co. The purchase was so many years purchase of the preceding three years' average profit. Owing to the fact that costs had risen very much during the period following the war, and the fact that the company was not able to raise its charges in time, the profits for some part of the three years were abnormally low. In this case a House of Lords Committee had altered the terms of the earlier Act, and the purchase was now to be by arbitration.

Sir HARRY HAWARD suggested that this was going against the law of average. What about the abnormality being the other way?

Mr. TYLDESLEY JONES said he did not think it would be unreasonable for the argument to apply both ways.

This closed the West Kent Co.'s evidence.

Here the Chairman asked the several opponents which of them was going to make an offer to the S.E. & C. Railway Co., in addition to the offer of the West Kent Co.

The Hon. EVAN CHARTERIS, K.C., for the County of London Co., said he was.

Mr. TURNER, for the Conference of Local Authorities, Mr. KENNEDY, for the London Companies' Joint Committee, and Mr. Craig Henderson for the L.C.C., all said that they were not proposing to make an offer to supply the Railway Co.

The Hon. EVAN CHARTERIS, K.C., then opened the case for the County of London Electric Supply Co., and said he proposed to call Mr. C. H. Merz as his principal witness.

The CHAIRMAN asked if the Commissioners were to understand that the County of London Co. represented itself to be an authorised undertaker—under Section 11 of the Electricity (Supply) Act, 1919—willing and in a position to give the Railway Co. a supply at a price not higher than that at which the Railway Co. could generate power for itself.

Mr. CHARTERIS said that was exactly his position. Moreover, he claimed that the erection of a power station for the specific purpose of supplying a Railway Co. and no other consumer was diametrically opposed to the best interests of electricity supply development in the London area.

Counsel then related how the County of London Co. had had its Barking station, with a capacity of 100,000 kW, authorised by the Commissioners, upon terms by which it was purchaseable by a joint electricity authority if so desired before August, 1926, upon terms to be determined by the Commissioners.

Mr. CRAIG HENDERSON, for the L.C.C., raised the objection that as the Barking station of the County of London Co. had been authorised for the statutory requirements of the County Co. only, any extension of those requirements ought to be the subject of a special application to the Commissioners. No notice of such an application had been made, and as the County Co. could not at present supply the Railway Co., and the latter being outside the area of supply, this raised an important matter from the point of view of the L.C.C., which was the purchasing authority in London, and this ought not to be dealt with at that inquiry.

Mr. CHARTERIS said the company had powers to link up its north and south London areas, and the supply could be given to the Railway Co. in the County Co.'s southern area.

The CHAIRMAN said that under Section 11 of the Act, if any authority came forward and said it was able to give a supply, the Commissioners must consider the offer.

Mr. HENDERSON said this only referred to an undertaker authorised to give a supply to a railway company.

The CHAIRMAN said this raised a point of importance, and he would like to consult his colleagues.

After a brief consultation, the Chairman said the Commissioners were of opinion that Mr. Charteris should be heard, and that Mr. Craig Henderson would have ample opportunity to criticise the offer Mr. Charteris was going to make.

Mr. CHARTERIS then dealt with the general position of the Railway Co. in this matter. He said that notice to electrify under the Railway Companies Act, 1903, was only given on May 19th, 1922, and that involved the consent of the Ministry of Transport, after an inquiry had been held to hear objectors, and a period of three months was allowed for objections to be lodged. This took the matter to August 18th, 1922. Therefore, the order to go ahead could not be given by the Railway Co. until after the inquiry was held. On the other hand, the County of London Co.'s plans for the Barking station were so far advanced that the order to go ahead could be given at once, and the County Co. would be in a position to give the supply before the Railway Co. would

be in a position to receive it, and certainly before June, 1925, when the equipment of the lines had to be ready under the guarantee arrangements with the Advisory Committee under the Trade Facilities Act. Estimates would be given showing a saving of £483,000 on capital expenditure on the part of the Railway Co., if supply were taken from the County Co. The supply would be given at 50 cycles, which, it was contended, was the best for general supply, and no difficulty would be experienced in converting that to 25 cycles for the purpose of the Railway Co. The position taken up by the County Co. was that it did not wish to criticise the proposals of the West Kent Co. in this matter, but if the Commissioners did not approve of the West Kent scheme, then there was this offer of the County Co., to displace the Railway Co.'s proposal to build a power station. The Barking site being on the north side of the river, would necessitate a tunnel under the Thames, but the County Co. had authority to connect up its northern and southern areas, and the tunnel would be built in any event. Moreover, the Barking power station was not much further away from the Lewisham sub-station of the Railway Co. than the proposed Belvedere power station of the West Kent Co., and very little more remote from it than the proposed Railway Co.'s power station at Angerstein's Wharf. The County Co. now had an industrial load of 30,000 kW, and was turning away further demands on account of lack of facilities. Therefore, it was necessary to proceed with the Barking station, and then there would be ample supply available for dealing with the railway load.

The CHAIRMAN said that during the inquiry into the Barking station, it was put forward that when this was built, the two congested London stations of the County of London Co. would be shut down. Did the supply to the Railway Co. mean a delay in shutting down the existing stations?

Mr. CHARTERIS asked that the point should be dealt with by Mr. Merz.

On Tuesday, June 13th, Mr. C. H. Merz was called in support of the County of London Electric Supply Co.'s opposition to the S.E. Railway Co.'s application. The offer of the County of London Co. was in the following terms:—

(1) The County of London Co. undertakes to supply electrical energy to the S.E. Railway at a periodicity of 50 cycles per second, and a pressure of 33,000 V. The supply is to be sufficient to deal with a railway load equivalent to 30,000 kW of demand on a half-hour rating. (2) The County of London Co. undertakes to pay the increased capital cost of motor-generators and transformers at 50 cycles, as compared with rotary converters and transformers at 25 cycles, as may appear on actual tenders approved by both parties. (3) The full supply to be available within three years from June 30th, 1922, and the payment under this agreement to start from that date. The County of London Co. will place at the disposal of the S.E. Railway Co. a supply of energy for testing trains by the end of 1924. (4) The S.E. Railway Co. to pay for this supply a fixed annual rental equal to 7.4 per cent. (4.5 per cent. interest, plus 2.9 per cent. depreciation) on the estimated capital cost of the S.E. Railway Co.'s Angerstein's Wharf power station and the transmission mains from that station, according to the tables presented by Mr. C. P. Sparks for the S.E. Railway Co. as finally amended at the inquiry held by the Electricity Commissioners in June, 1922, or such other rate of interest at which the Commissioners may be satisfied that the necessary capital can be raised by the S.E. Railway Co., plus such further annual sum as the Commissioners may determine to be the proper amount to be added for depreciation. (5) The S.E. Railway Co. to pay the actual local rates paid by the County of London Co. in respect of 45,000 kW of plant at Barking. The S.E. Railway Co. to pay the actual local rates incurred by the County of London Co. in transmission mains in respect of a capital value of £65,000. (6) The S.E. Railway Co. to pay, as a running charge, the cost per kWh, other than the fuel cost, estimated by the S.E. Railway Co.'s witnesses for operating and maintaining the suggested station at Angerstein's Wharf with a minimum equivalent to 25 per cent. of the said operating and maintenance cost for a load of 29,000 kW. (7) The S.E. Railway Co. will pay, as a fuel charge, the actual cost of fuel incurred by the County of London Co. on the basis of 20,000 B.th.u. per kWh sent out from Barking at 33,000 V. (8) The County of London Co. will allow a rebate on the fuel cost of half the difference between the coal consumption per kWh sent out from Barking at 33,000 V, and 20,000 B.th.u. (9) The County of London Co. will allow a further rebate of 4 per cent. on the running charges and coal bill, on account of the decreased efficiency of motor generators. (10) For all extensions of the S.E. Railway Co.'s electrification the County Co. undertakes to supply electrical energy on similar lines as above, and the S.E. Railway Co. agrees to take such additional supply. (11) Arbitration clause on usual lines. (12) Period of agreement, minimum of 25 years; coal strike, and land clauses.

Sir HARRY HAWARD promptly pointed out that the offer did not state a price per kWh, and he asked for details of estimated costs and a figure for the cost per kWh.

Mr. MERZ's reply was that if full details of this nature were to be disclosed, it would be impossible for any commercial undertaking to come to an agreement. The offer was capable of being translated into a precise figure sufficiently close for the Railway Co.'s purpose.

Sir HARRY HAWARD said that a definite figure of cost per kWh had been put in both by the S.E. Railway Co. and the West Kent Co., and the Commissioners would desire a similar figure from the County of London Co.

Sir JOHN SNELL concurred in this.

Eventually, later in the day, Mr. Merz said that the figure worked out to 0.481d. per unit.

In the course of the explanation by Mr. Merz of the offer set out above, Mr. Clode, K.C., for the Railway Co., said he could not accept the arbitration of the Commissioners as to the interest and depreciation charge.

Mr. TYLDESLEY JONES, K.C., for the West Kent Co., pointed out that the point of delivery of the power was not mentioned in the offer.

Mr. MERZ replied that for practical purposes, it would be the Lewisham sub-station of the Railway Co. Later, he explained that the intention was to carry the cables through the tunnel to be constructed under the Thames on to the railway track, and carry them along to Lewisham. If a technical objection was taken to the County Co.'s metering outside its area then the supply would be given from the Camberwell area of the County Co., and metered from there. Answering further questions, Mr. Merz said it was intended to put down an additional 35,000-kW set at Barking, *i.e.*, four instead of three. The tunnel under the Thames would be 6 feet in diameter and the cost was put at £70,000, which was more than the price which had been quoted. He did not anticipate any trouble in getting the consent of the Port of London Authority to the construction of the tunnel. The figure of 0.481d. per kWh was for a.c. delivered at Lewisham, after allowing 4 per cent. for the difference in efficiency as between motor generators and rotary converters. Mr. Merz added that the offer was not necessarily the best that might be arrived at if the Railway Co. and the County Co. got to actual negotiations. There were points outstanding which business men would have no difficulty in overcoming, but the offer as it stood was put forward as complying with Section 11 of the Electricity (Supply) Act, 1919.

Mr. ROBERT H. HOUGHTON, chief electrical engineer to the London, Brighton & South Coast Railway Co., was called by the Commissioners. He said that 69.2 single track miles or 22.41 route miles were at present electrified, and that a further 5.8 route miles or 25.6 single track miles were in hand. This would carry the L.B. & S.C. electrified lines to West Croydon. A scheme had been prepared for electrifying the whole of the suburban lines of his company amounting to 101 route miles, or 400 miles single track, including those mentioned above, and this would need 200 million kWh per annum. The electrification of the lines to the coast was a separate scheme. The present load factor was 37 per cent., and the maximum load on a one-hour rating was 5,000 kW. The power taken last year amounted to 16,080,000 kWh. When the whole of the suburban lines had been dealt with, he estimated that the maximum demand would be 63,000 kW, with a load factor of just over 40 per cent. The present system and the small extensions in hand were supplied at 6,700 V, but the intention was to change the whole system over to 11,000 V. No definite decision had yet been come to with regard to the completion of the suburban system. The company had found its supply from an outside source perfectly satisfactory.

(To be concluded.)

ELECTRICAL DEVELOPMENT AT HACKNEY.

THE Metropolitan Borough of Hackney bids fair to be one of the pioneers of the popularisation of electrical methods in this country. Following upon the excellent exhibition which was held recently, another important move has been made. Already the price of energy in the borough is very much below the average—6d. for lighting, and 1d. for heating and cooking*—which is in itself an important factor in the extension of the use of electricity. The Borough Electrical Engineer (Mr. L. L. Robinson) was recently requested to draw up a scheme whereby electricity for *all* domestic purposes might be brought within the reach of families of limited means—a considerable portion of the denizens of a borough such as Hackney. The first consideration was the relief of the prospective consumer from the burdensome initial cost of installation. It was, therefore, suggested that the Council should bear this in the first place—repayment by the consumer being gradual—the expenditure being charged to revenue account. This matter having been met, the low price of energy in the district would do the rest. Mr. Robinson acknowledges his indebtedness to the Gas Light & Coke Co. for the suggestion, as his company, realising how much revenue might be obtained by a graduated system of re-

*We are informed that the 1d. rate applies to the summer quarters only, at present, the winter rate being 2d. per unit; owing, however, to the increased efficiency of the station, the Engineer has recommended that the 1d. rate be instituted for the whole year.—EDS. ELEC. REV.

paying installation costs, has already in operation a method involving this principle. There is nothing undignified in adopting the scheme of a competitor, and gas has gleaned more than one useful inspiration from electricity.

The installation proposed, while comprehensive enough to meet the needs of the average household, is simple and comparatively inexpensive. For lighting a six-pendant installation is suggested. This would comprise the service, a meter, wiring, switches, fuses, and plain pendant fittings terminating in shade carrier cord-grip holders. The cooking installation would consist of a standard cooker and a 3-pint kettle, similar to those already dealt with in the Council's ordinary hiring scheme, with the necessary service, meter, and wiring. Standard radiators, as used in the ordinary hiring scheme, would be installed for heating, together with service, meter, &c. It will be noticed that, although as will be seen later, the price per unit for heating and cooking would be the same, separate services and meters are proposed for the two parts of the installation. This, it may be presumed, is to allow the use of either heating or cooking separately if desired. Where both were installed no doubt one service and one meter only would be provided. Turning to the consumer's liability in the first instance, it is proposed that he shal pay outright for the provision and maintenance of lamps and glassware, and for any special convenience, decorative lights, or portable articles such as immersion heaters, irons, and similar appliances. The supplies would be given through shilling-in-the-slot prepayment meters and the charge would be 2d. per unit in excess of the ordinary flat rate for lighting, and ½d. in excess of the ordinary cooking and heating rate; based on present prices this would amount to 8d. and 1½d. per unit respectively.

To enable an idea of the probable results to be gained, the report presents what would be typical installations. Assuming a six-light installation, costing 30s. per point, the wiring would cost £9; the service and meter would cost £5; making a total expenditure of £14. The consumption of such an installation would probably be 150 units per annum; at 8d. per unit, the consumer's bill would, therefore, be £5 per annum. Of this sum 2d. per unit would be taken for fixed charges on the service and installation and would amount to £1 5s. per annum. The value of the installation would be stated when installed, and the consumer would have the option, at any time, or by instalments, to pay the sum, and, upon completion of payment, would be entitled to have the charge per unit reduced to the ordinary rate for consumers who have provided their own services and installations. The complete cost of a cooking installation is £20, and the consumption for a family of four would average 1,000 units per annum. At 1½d. per unit this would amount to £6 5s. per annum, and, taking ½d. per unit for fixed charges, a sum of £2 1s. 8d. would be obtained. As with the lighting installation, the consumer would have the option of purchasing the installation, involving the right to be supplied at the same rate as ordinary consumers.

The Council would not be compelled to give these terms to anybody who applied for them, but would be empowered to satisfy itself as to the standing of applicants, or to demand security.

Mr. Robinson concludes his report by expressing his confidence in the success of the scheme outlined, and hopes that it will be tried on a scale which will lead to practical results. He suggests that £5,000 should be "earmarked" out of revenue for the purposes of the scheme, and that installations involving the expenditure of this amount should be sanctioned. A further detailed report would then be submitted before the scheme was carried any further.

The Finance Committee, reporting on the matter, passes the estimate of £5,000 subject to the Council's sanctioning the proposals.

As the sum suggested will provide for the equipment of about 150 houses it will be seen that the experiment is on an adequate scale, and it is to be hoped that the results obtained will enable the Council to proceed still further with the scheme until Hackney becomes an "all-electric" borough.

DEVELOPMENT WORKS IN URUGUAY.

H.M. Commercial Secretary at Montevideo (Captain Eric Buxton) in his report* on economic conditions in Uruguay up to November last, states that the port scheme, which is estimated to cost $13,000,000, is likely to take six years in execution. The suggested works comprise a new basin for river craft, a new pavilion for passengers, a produce market, a slipway, the purchase of dredging plant, the deepening of the entrance channel and basins, and the construction of a new dry dock and sundry buildings. It is proposed to spend some $143,000 on improvements at the small Atlantic port of La Paloma.

Extensions are also to be made at the three principal ports on the Uruguayan bank of the River Uruguay. Work has been commenced at Paysandú in connection with the improvements contracted by the French firm of Hersent; it is proposed to lengthen the existing mole, and generally improve the present means for dealing with passenger and cargo traffic, at an expenditure of some $225,000. Following a call for tenders which brought quotations from 15 firms, the Uruguayan Government decided to award the contract for the supply of electric cranes for the port of Paysandú to a German firm.

Certain improvements are likely to be carried out at Salto, a Bill having been laid before Congress authorising the expenditure of $240,000 for the purpose of extending the existing wooden mole and providing it with more adequate means for handling cargo. The construction of water works and drainage at eight towns in the interior is being undertaken. Payment will be made in Bonos de Saneamiento. These bonds, which cannot be issued at less than 93 per cent., bear 6 per cent. interest and 1 per cent. amortisation per annum.

Work is in progress in connection with the drainage works which the municipality of Montevideo decided to carry out in the south-east part of the city known as "La Estanzuela," at an estimated cost of $1,470,000. In this case the successful tenderer is a German firm.

The report refers to the scheme which has been laid before Congress whereby the horse-drawn tramways, known as the *Tranvia del Norte*, would be electrified and thus placed on a par with the other companies, both of which adopted electric traction some years ago. The scheme comprises the laying of 25 miles of track with overhead wires, a power house, two sub-stations, 50 electric cars, 20 trailers, the paving of certain lengths of track and re-paving in other cases, car barns and workshops, underground feeders, &c., and the cost is estimated at 2¼ million dollars. It is proposed to raise this amount by an issue of mortgage debentures.

Considerable progress in certain manufacturing industries has been made in Uruguay. Their establishment is encouraged by virtue of a law under which the machinery required for the installation of specific works is exempt from import duties, and relief is afforded in the matter of taxation on the exploitation of the works.

With the aid of imported brass and iron tubes, rods and wire, the making of bedsteads, wire mattresses, curtain rods, and other metal fittings is fairly extensively carried out; local factories are also turning out building brassware, and to the brass and iron foundries must now be added a recently established steel foundry, the first of its kind in the country.

The Board of State Electrical Stations controls the production and supply of electricity in Montevideo. During the financial year ended June 30th, 1920, the energy generated amounted to 52,000,000 kWh, of which 45,000,000 kWh was consumed; the net profits amounted to $1,268,543. A considerable number of the consumers are on the power mains. The State also controls a large chemical plant known as the Institute of Industrial Chemistry.

While the sale of British goods has been made difficult by the premium of about 25 per cent. at which sterling has been quoted in the exchange market for several months past, the representatives of German manufacturers have had little trouble in securing the major portion of the orders in many lines of business. The premium at which United States' funds have been quoted has been extraordinarily high, the rates of exchange having attained figures which represented a premium of 60 to 70 per cent., with the result that imports from that country have suffered a severe check.

Within the reduced number of orders placed by Uruguayan buyers German manufacturers have done a fairly considerable amount of trade owing to their quotations being invariably very much lower than any others. Despite the fact that the United Kingdom firms have reduced their prices, the premium at which sterling is quoted places their figures in an unfavourable position when in competition with German houses. The latter are sparing no pains to secure a prominent place in this market.

German electrical goods are on the market again, but it may be said that stocks of imports are generally low; yet the present would hardly be an opportune moment in which to urge British manufacturers desirous of establishing connections in Uruguay to incur expenditure in advertising in this market. Special stress must, however, be laid upon the desirability of all circulars distributed in Uruguay being printed in Spanish. In most lines the best means of approaching importers is through resident agents. At the present time, however, difficulties are experienced in obtaining the services of suitable local firms to act as agents for the sale of certain lines owing to the limited scope due either to small demand or to the difficulties arising from the premium on sterling. Many British firms are already represented in this market, and the various local British business houses constitute a very valuable means of distribution in Uruguay of goods manufactured in the United Kingdom. Most of the British business firms in this country are members of the British Chamber of Commerce in Uruguay, founded seven years ago, with headquarters in Montevideo.

*Department of Overseas Trade, price 1s.

The Metric System.—The use of the metric system has been optional in Greece since 1898; it is now about to be made obligatory.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Lock for Electric Lamps.

We have received a sample of a new lock (fig. 1) for incandescent electric lamps from The Francis Tool & Engineering Co., Ltd. This is a simple but effective device, consisting of two collars, one of which screws into the other. A ratchet fixed upon the inside of the outer collar engages, when the latter is turned in a right-handed direction, with shoulders running across the thread of the inner collar. The parts screw together easily in the opposite direction. In fitting the lock the lamp-holder is inserted into the inner collar with the outer

Fig. 1.—The Francis Lamp Lock.

part screwed home, and the lamp is put in. Then the outer collar is screwed down until it lightly rests upon the top of the lamp. As it is impossible to turn the collar and move it upward again, it will be seen that the lamp is effectively retained in position. The only feature which may or may not be considered a drawback to the use of this device is the fact that the lamp must be broken to be removed; a special bag is provided for this purpose.

The "Teletype" Intercommunicating Machine.

A simple machine for exchanging telegraph messages between two or more points, made by the Morkrum Co., of Chicago, was recently described by the *Telegraph & Telephone Age*. The "Teletype," as it is called (fig. 2) is worked by the depression of lettered keys, which causes varying currents to be sent over a line and characters corresponding to the keys

Fig. 2.—The "Teletype" Signal Printing Machine.

are printed on a narrow ribbon of paper, both at the transmitting and receiving ends. The printing is effected by bringing the paper ribbon into contact with characters on the rim of a type wheel. The latter is attached to the main shaft of the printing unit, and revolves with the shaft, which is driven by a small motor through a system of gears and a clutch. The keyboard transmitter consists of a bank of lettered key levers, a set of notched selector bars, a contact mechanism, and a clutch, through the medium of which the contact-operating mechanism is driven. The system employed to transmit the characters is a five-unit code. If a given unit of time be divided into five intervals, during each of which current may or may not be transmitted, it is possible to produce thirty-two different combinations of current, and no-current intervals. Thus, in the case of the letter "E," current will be sent during the first interval and no current during the next four intervals. The letter "R" will require current during the second and fourth intervals, and no current during the first, third, and fifth intervals. Each combination of signals is preceded by a "start" and followed by a "stop" signal. The first step in the selection of a combination to be transmitted is the movement of the selector bars. Beneath the key levers are five bars, flat steel strips set on edge at right-angles to the key levers, and they extend across the width of the keyboard. These bars are numbered from 1 to 5, corresponding with the intervals of the signal code. The selector bars are guided at each end and rest on rollers so that they may be easily moved endwise. The top edge of each bar has a number of triangular notches cut into it, arranged according to the requirements of the code. When a key is depressed the key lever strikes the slanting sides of these notches, moving the bars either to the right or left, depending upon whether the key lever strikes the right or left incline of the notch in the selector bar.

"Cantie" Distribution Boards.

The accompanying photograph (fig. 3) shows an interesting example of distribution fuseboards. The boards form distribution points in a ring main system, the cables of which are .15 three-core paper-insulated, lead-covered and armoured. Each cable is brought to a gland, then through a sealing chamber, from whence each core is taken to a terminal coupled to a busbar by means of a removable copper link. This link having a slot at the lower end and being fixed with wing nuts, can be moved aside so as to disconnect and isolate any core. The busbars are taken from the link chamber to the fuse chamber through tubes, being sheathed in mica where passing through the tubes. The fuses are of the "Cantie" patent type, and are of 50-A and 100-A capacity.

The whole of the insulation is of mica and china. The terminals, links, and busbars are carried on mica-covered steel rods, which are securely bolted in position. The fuses are supported on rectangular steel rods which fit into grooves in the china bases. The insulation test was 3,000 V. a.c., applied for 30 minutes, and the flash test was 6,000/7,000 V. a.c. Not a single failure or weakness was perceptible in any part.

Every terminal and fixing screw is accessible from the front of the box, and any fuse bridge or base can be removed and replaced without interfering with any other bridge or base. The cases are of cast iron with cast-iron hinged lids. The lids are fitted with watertight joints, and a lock and key.

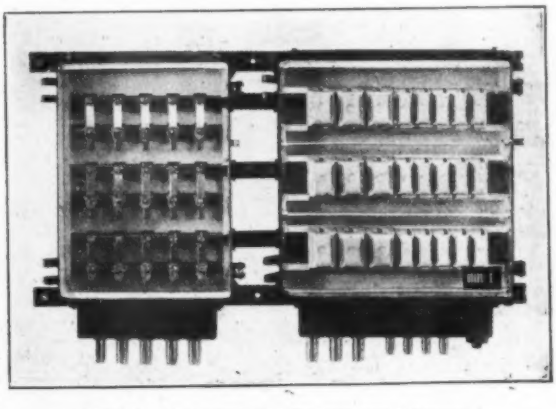


Fig. 3.—"Cantie" Distribution Boards.

In all there are nine boards, the largest ones being about seven feet by three feet, and when packed the aggregate weight was about four and a half tons. They were supplied to the Calcutta Electric Supply Corporation, Ltd., to the specification of Messrs. Kennedy & Donkin, by the Cantie Switch Co., Ltd., Leighton Street, Nottingham.

NEW PATENTS APPLIED FOR, 1922.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

14,666. "Starters, circuit breakers, &c., for electric motors." E. N. Bray. May 25th.
14,667. "Means for making electric connections." E. N. Bray. May 25th.
15,011. "Method of forming joints between tramway rails, &c." H. W. A. Brown. May 29th.
15,167. "Thermionic valves, &c." C. F. M. Hayes and Mullard Radio Valve Co., Ltd. May 30th.
15,172. "Light generators for medical light treatment." E. Steinberg. May 30th.
15,199. "Head-lights for motor, &c., vehicles." E. V. Lowe and F. G. Evans. May 30th.
15,200. "Terminals for electric transformers." B. Beesley, J. B. Hansell, and Metropolitan-Vickers Electrical Co., Ltd. May 30th.
15,201. "Electric transformers." Metropolitan-Vickers Electrical Co., Ltd. May 30th. (United States, June 3rd, 1921.)
15,202. "Processes for making alloys." British Thomson-Houston Co., Ltd. (General Electric Co.) May 30th.
15,204. "High-frequency telegraph and telephone systems." Ges. für Drahtlose Telegraphie. May 30th. (Germany, June 1st, 1921.)
15,214. "Electric heating apparatus." A. M. E. Beavan. May 30th.
15,228. "Transmitter for telephony, &c." A. T. Thompson. May 31st.
15,229. "Electric indications of lamps being alight." E. Kirk. May 31st.
15,237. "Sound conduits and amplifiers for wireless telephones and recorders." A. E. Roberts and L. H. Thompson. May 31st.
15,296. "Prepayment apparatus for telephones." W. H. Jones and W. A. Robinson. May 31st.
15,304. "Multiplex telegraphy." F. E. Pernot and L. J. Rich. May 31st.
15,305. "Current direction indicator." Deutsche Glimmlampen Ges. and J. M. Schmierer. May 31st. (Germany, March 30th, 1921.)
15,306. "Wireless receiver sets." W. E. Peek. May 31st.
15,307. "Variable condensers." W. E. Peek. May 31st.
15,320 "Electric switches." T. W. Bennett. May 31st.
15,329. "Solenoids." C. Tor Cock. May 31st.
15,332. "Incandescent electric lamps." A. H. Brunessaux and Metropolitan-Vickers Electrical Co., Ltd. May 31st.
15,334. "Electrolytic protection of boilers, &c., from corrosion, &c." Siemens-Schuckertwerke. May 31st. (Germany, June 1st, 1921.)
15,346. "Controlling magneto-electric machines." Rudge-Whitworth, Ltd., and W. H. Whitmill. May 31st.
15,349. "Electric outfit for games or demonstrations." M. Latour. May 31st. (France, June 4th, 1921.)
15,351. "Dry batteries." Soc. Anon. Le Carbone. May 31st. (France, May 1st.)
15,359. "Metallic-vapour electric rectifier." Bureau d'Organisation Economique. May 31st. (France, June 2nd, 1921.)
15,365. "Electric condensers." W. T. Ditcham. May 31st.
15,367. "Wireless telegraph receiving circuits." H. J. Round. May 31st.
15,368. "Burglar alarm, &c., electric circuits." J. R. Coltman and W. Davan. May 31st.
15,374. "Sparking plug." E. Fairhurst and J. Winstanley. June 1st.
15,381. "Incandescent electric lamps." J. Walmsley. June 1st.
15,408. "Electro-magnets." H. R. Jones and C. E. Wood. June 1st.
15,442. "Electrically-illuminated signs for advertising, &c." F. M. Thompson. June 1st.
15,448. "Magneto-electrical systems for igniting and illuminating motor vehicles." Fahrzeugfabrik Eisenach Zweigniederlassung der Gothaer Waggonfabrik Akt. Ges. in Gotha. June 1st. (Germany, March 31st.)
15,452. "Electric clocks." C. E. Prince. June 1st.
15,460. "Electric condensers." Dubilier Condenser Co. (1921), Ltd., and W. H. Goodman. June 1st.
15,462. "Surface condensers." Schneider et Cie. June 1st. (France, May 4th.)
15,472. "Electric protection systems." J. P. Williams. June 1st.
15,473. "Electric distribution apparatus." W. T. Henley's Telegraph Works Co., Ltd., E. E. Judge, and E. Moor. June 1st.
15,476. "Manufacture of metal filaments." General Electric Co., Ltd. June 1st. (Germany, June 18th, 1921.)
15,480. "Sparking plug." W. Hedgecoe. June 1st.
15,481. "Automatic telegraphy." E. S. Heurtley and Muirhead & Co., Ltd June 1st.
15,483. "Electrical connections for batteries." British Battery Co., Ltd., and J. W. H. Reynolds. June 2nd.
15,493/5. "Electric lifting blocks, &c." C. L. Browne and S. H. Heywood & Co., Ltd. June 2nd.
15,494. "Electric controllers." C. L. Browne and S. H. Heywood and Co., Ltd. June 2nd.
15,516. "Electric arc devices." P. Freedman. June 2nd.
15,532. "Electrical variable condensers." E. R. Maddox. June 2nd.
15,543. "Railways and tramways." F. E. Down. June 2nd.
15,551. "Electric heating units for laundry irons, cooking apparatus, &c." H. Booth. June 2nd.
15,573. "Portable searchlights." W. J. Curtis and Gas Accumulator Co. (United Kingdom), Ltd. June 2nd.
15,584. "Receiving apparatus for oscillating electric circuits." R. L. Murray and Telephone Manufacturing Co., Ltd. June 2nd.
15,594. "Electrical connectors, terminals or binding posts." A. R. Matthews and R. F. Tumner. June 2nd.
15,596. "Telephone systems." Siemens and Halske Akt. Ges. June 2nd (Germany, June 21st, 1921.)
15,633. "Automatically lighting electric street, &c., lamps." C. A. Coleman. June 6th.
15,636. "Magnetos." R. Simpson. June 6th.
15,654. "Apparatus for cleaning sparking plugs." R. E. Sprott. June 6th.
15,681. "Automatic electric switches." F. B. Cox. June 6th.
15,690. "Insulated cable." J. R. Laird and G. Pate. June 6th.
15,709. "Alternating current transformers." B. H. Leeson and W. D. Owen and A. Reyrolle & Co., Ltd. June 6th.
15,710. "Selective switches for electric inductances, &c." D. H. Brayne. June 6th.
15,730. "Primary electric batteries." J. A. Slee. June 6th.
15,737. "Electric lamp fittings." M. J. Railing and C. W. Saunders. June 6th.
15,744. "Galvanic cells." H. D. Nyberg. June 6th.
15,749. "Central battery exchange telephone systems and switchboards." F. R. Baldock and International Electric Co., Ltd. June 6th.
15,750. "Electric switching apparatus." H. Barón (F. Aldendorff). June 6th.
15,751. "Electro responsive devices." British Thomson-Houston Co., Ltd., and A. S. FitzGerald. June 6th.
15,765. "Means for insulating and protecting electric wires or cables." G. W. Humphry. June 6th.
15,767. "Electric ignition devices for internal-combustion engines." Skywing Aircraft Corporation. June 6th. (United States, December 1st, 1920.)
15,808. "Instrument for distributing audibility of wireless speech, &c." W. H. Smith. June 7th.
15,815. "Electric lamps." D. H. Walters. June 7th.
15,817. "Wireless tuning inductances." J. B. Bignamy and H. R. Howling. June 7th.
15,830. "Controllers for electric circuits." British Thomson-Houston Co., Ltd., and R. D. Given. June 7th.
15,845. "Telephone systems." Western Electric Co., Ltd. June 7th, (United States, June 16th, 1921.)
15,849. "Devices for amplifying sounds." T. H. Williams. June 7th.
15,852. "Apparatus for driving talking machines." Allgemeine Elektricitats Ges. June 7th. (Germany, June 25th, 1921.)
15,857. "Telephone receivers." F. Clark and Sterling Telephone and Electric Co., Ltd. June 7th.
15,859. "Electric switches." H. W. Breeze, W. T. Henley's Telegraph Works Co., Ltd., and H. S. Wheeler. June 7th.
15,865. "Burglar alarms." W. Harris. June 7th
15,884. "Electric resistances." F. Pellin and G. Pelletier. June 8th. (France, June 8th, 1921.)
15,891. "Sparking plugs." A. A. Scott. June 8th.
15,902. "Wireless telephone advertising cabinets." W. H. Brook. June 8th.
15,918. "Electric generators." L. M. Perkins. June 8th.
15,926. "Semi-automatic electric lighting systems." R. S. C. Ball and M. Webber, Ltd. June 8th.
15,935. "Apparatus for electrical transmission of photographs, &c." G. R. Judge and R. A. Storey. June 8th.
15,937. "Electric control apparatus." A. O. Kolstad and Marine Motor Machinery Co. June 8th.
15,942. "Transmitting and receiving apparatus." G. F. Critchley and A. Peel. June 8th.
15,953. "Means for exciting alternating-current motors, &c." R. R. R. Sarazin. June 8th. (France, June 21st, 1921.)
15,965. "Sparking plugs." O. E. Jones. June 8th.
15,969. "Means for gripping electric cables in junction boxes, &c." Johnson & Phillips, Ltd., and C. J. H. Stevens. June 8th.
15,972. "Wireless receiving systems." B. Guest. June 8th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1920.

32,418. "Plug connection boxes for electric cargo lights." W. Henderson and Telford, Grier & Mckay, Ltd. November 17th, 1920. (180,348.)
32,569. "Selective circuits for use in connection with alternating currents." E. Potter (F. E. Pernot and L. J. Rich). November 18th, 1920. (180,349.)
35,861. "Telephonic conversation meter." R. Ferry. December 21st, 1920. (180,362.)

1921.

1,305. "Telegraphic and telephonic transmission by single line without earth return." L. Duverger. February 16th, 1918. (157,385.)
1,306. "Telegraphic and telephonic transmission by single line without earth return." L. Duverger. January 15th, 1919. (Addition to 157,385.) (157,386.)
1,750. "Plug and socket electric couplings." W. J. Polyblank. October 11th, 1921. (180,369.)
2,683. "Tumbler switches." Y. Takaoka. January 20th, 1921. (180,378.)
4,770. "Indicators or annunciators," E. A. Graham. February 10th, 1921. (180,393.)
5,095. "Electrical measuring indicating or relay apparatus for polyphase circuits." Metropolitan-Vickers Electrical Co., Ltd. February 13th, 1920. (159,147.)
5,096. "Electrical measuring or indicating or relay apparatus for polyphase circuits." Metropolitan-Vickers Electrical Co., Ltd. February 13th, 1920. (159,148.)
5,107. "Apparatus for rectifying alternating-electric currents." Thorpe Electric Corporation. December 23rd, 1920. (173,200.)
5,231. "Generation of high-frequency alternating electric current." British Thomson-Houston Co., Ltd., and E. F. W. Alexanderson. February 15th, 1921. (180,400.)
5,392. "Thermionic valves." W. J. Mellersh-Jackson (Soc. des Etablissements Gaumont). February 16th, 1921. (180,405.)
5,619. "Sparking plugs for internal-combustion engines." C. S. Harrison. February 18th, 1921. (180,412.)
5,643. "Insulators for suspended high-tension electric wires." A. Renaudin. February 23rd, 1920. (159,198.)
5,708. "Dynamo-electric machines." Lancashire Dynamo and Motor Co., Ltd., and C. P. Bramley. February 19th, 1921. (180,414.)
5,847. "Hand-operated mechanism for operating electric controllers and other purposes." A. West & Co., Ltd., and A. West. February 21st, 1921. (180,419.)
5,894. "Thermionic valve transmitters." Ges für Drahtlose Telegraphie. February 28th, 1920. (159,463.)
5,971. "Type of sparking plug for internal-combustion engines." H. S. J. Hughes and J. W. Hughes. February 22nd, 1921. (180,428.)
6,040. "Appliance for indicating location of faults in section feeder boxes of systems of electric traction and in lead-sheathed or armoured main cables." Brecknell, Munro & Rogers, Ltd., and F. W. Brecknell. February 22nd, 1921. (180,434.)
6,121. "Protective apparatus for dynamo-electric machines." J. A. Kuyser, G. A. Juhlin and Metropolitan-Vickers Electrical Co., Ltd. February 23rd, 1921. (180,435.)
6,168. "Apparatus for testing the electric characteristics, more especially resistance, of fluid and other materials." V. Planer. May 17th, 1920. (163,682.)
7,559. "Electric power transmission and braking systems." British Thomson-Houston Co., Ltd. (General Electric Co.). March 9th, 1921. (180,456.))
7,677. "Electrical heating devices." S. M. Carmean and J. H. Carmean. March 13th, 1920. (160,162.)
8,473. "Dynamo-electric generator sets driven by air-cooled internal-combustion engines." A. A. Lyon. March 18th, 1921. (180,469.)
9,017. "Electric switches." D. McGregor and Bulpitt & Sons, Ltd. December 23rd, 1921. (180,480.)
10,249. "Spring contact members for electric circuits on motor road vehicles." E. G. Mottershead. April 7th, 1921. (180,503.)
10,809. "Enclosed electric fuses." A. L. Eustice. April 13th, 1921. (180,513.)
11,565. "Electric irons." H. H. Berry and W. J. Markham. April 21st, 1921. (180,525.)
11,857. "Dynamo-electric machines." G. A. Juhlin and Metropolitan-Vickers Electrical Co., Ltd. April 25th, 1921. (180,530.)
12,015. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. April 26th, 1920. (162,297.)
12,124. "Reflectors for searchlights." X. Bullinger. May 21st, 1920. (163,690.)
12,785. "Electric burglar alarms." "Polyp" Ges für Apparatebau der Feinmechanik Ges. and G. Wittwer. May 4th, 1921. (180,541.)
12,906. "Spark gaps." L. H. T. Holden. May 5th, 1921. (180,542.)
13,816. "Vacuum rectifiers." Siemens Schuckertwerke Ges. May 15th, 1920 (163,325.)
18,277. "Combined electric cable receiver and grip." A. E. Baxter. July 6th. 1921. (180,584.)
19,318. "Electrically-heated boilers." E. Meystre. September 8th, 1920. (Addition to 157,904.) (168,863.)
22,345. "Speed regulator systems for electric motors." Metropolitan-Vickers Electrical Co., Ltd. September 11th, 1920.) (169,154.)

1922.

11,852. "Insulators for suspended high-tension electric wires." A. Renaudin. February 23rd, 1920. (Divided application on 159,198.) (179,180.)
11,853. "Ligatures for connecting insulating elements for suspended high-tension wires." A. Renaudin. February 23rd, 1920. (Divided application on 159,198.) (179,181.)